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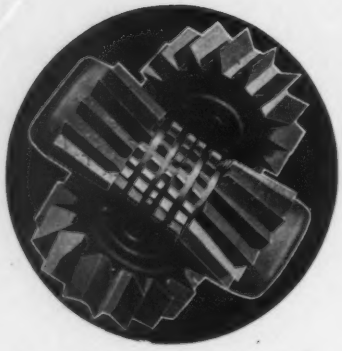

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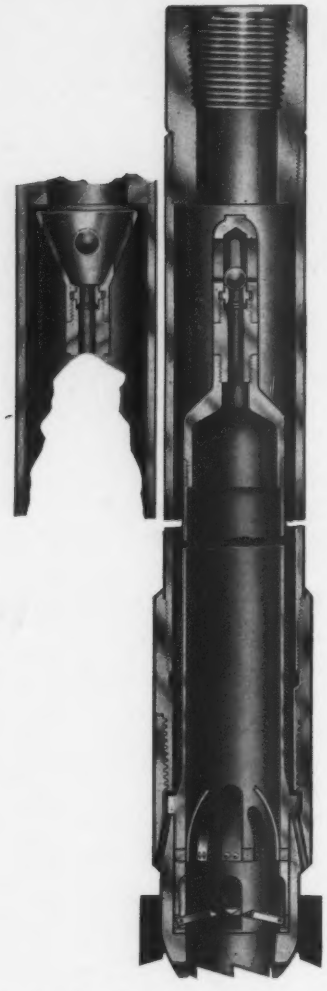

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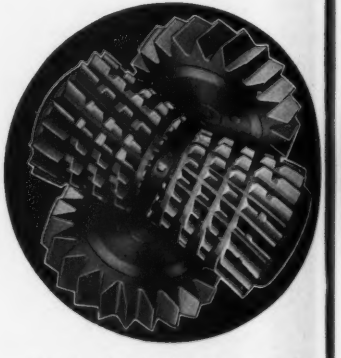

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# OIL WORLD
and Petroleum Industry

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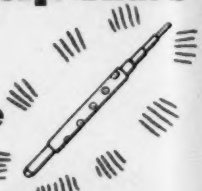

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# On The Defensive Again

The special session of the Congress is underway. That Congress will consider many legislative matters having to do with taxes, farm programs, wages and hours, and, according to the best information available, the percentage depletion allowance granted the oil and mining industries. There will be a definite effort to eliminate the allowance, or at least modify it, and it behooves every interested party—which means every man in the oil business—to exert whatever pressure he can to stop any modification of the allowance.

In that connection, J. D. Collett, operator of Fort Worth, Texas, spoke at the recent meeting of the A. P. I. at Chicago. In part, Mr. Collett's remarks were:

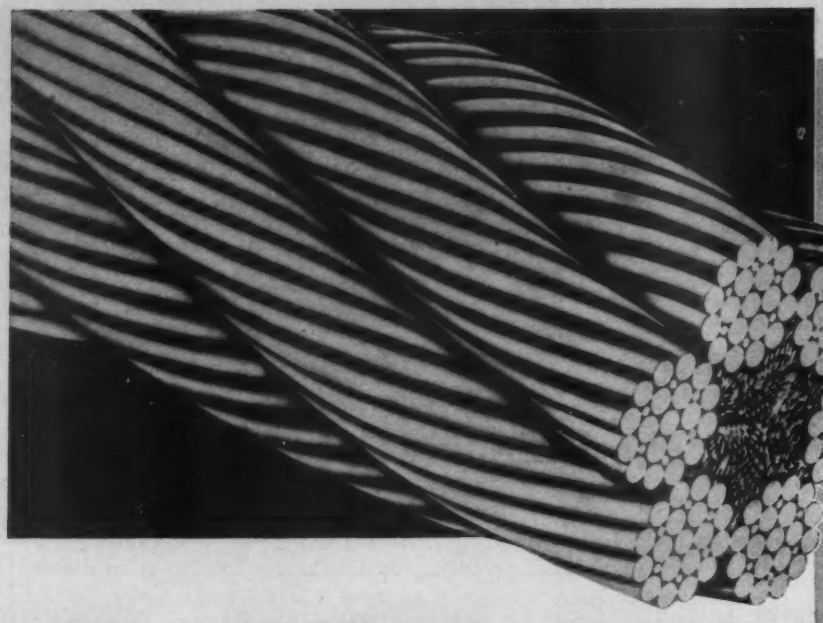
"I will not attempt to elaborate the sound principles on which the whole idea of a depletion allowance is based. Those principles are so well established, as they relate to the oil and mining industries, and they have been so long and so generally recognized, that one would think that they could not possibly be brought into question before any legislative body at this late day. It is undeniable that the extraction of petroleum or of any other mineral is in its very nature a process of depletion. On no sound basis could the proceeds of such a process be regarded as income pure and simple, in the sense that the return on capital invested in any other kind of an enterprise is income.

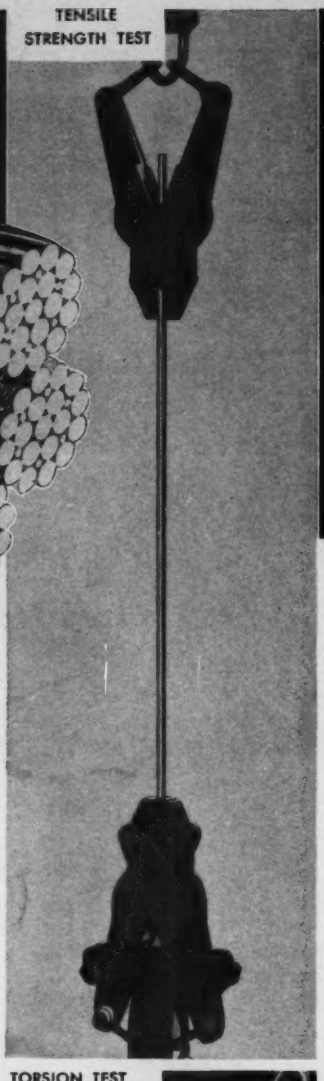
"An operator who expects to stay in business understands that every barrel of oil he extracts from a lease leaves that much less in the ground and, that so far as that lease represents his capital, he is reducing it all the time. He must recognize that he is using up his capital. If he does not recognize this, but treats the proceeds of the oil he extracts entirely as income, he will soon find his capital depleted. Now, our revenue laws are designed to levy taxes on income and not on capital, and if no allowances were made for depletion in income tax returns on the proceeds of produced oil, and if the Government insisted in treating it all as income, such taxation would amount to confiscation, because it would be in very fact the appropriation of part of the operator's capital.

"The percentage allowance has worked well. It has been fair and equitable to all—to the government first of all, and to the big and little operator alike. The older methods were especially unfair to the small operator, and I do not hesitate to say that anything that works against the small operator is against the best interests of the entire industry."

Which remarks, we think, should certainly be conveyed to each and every member of the present Congress.

**It is with sincere regret that the publishers of the California Oil World announce the resignation, effective Nov. 15, of Stark Fox, who has been associated with the publication for the past eight years and has been its editor for the past year. Mr. Fox has become associated with the Oil Producers Agency, and takes to his new work the best wishes not only of his associates in the publication, but also his many other friends in the industry.**



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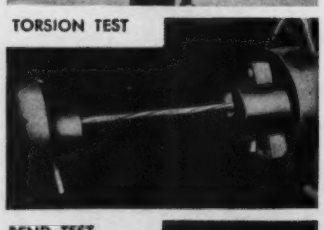


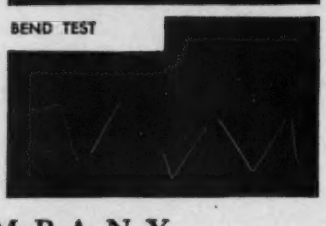


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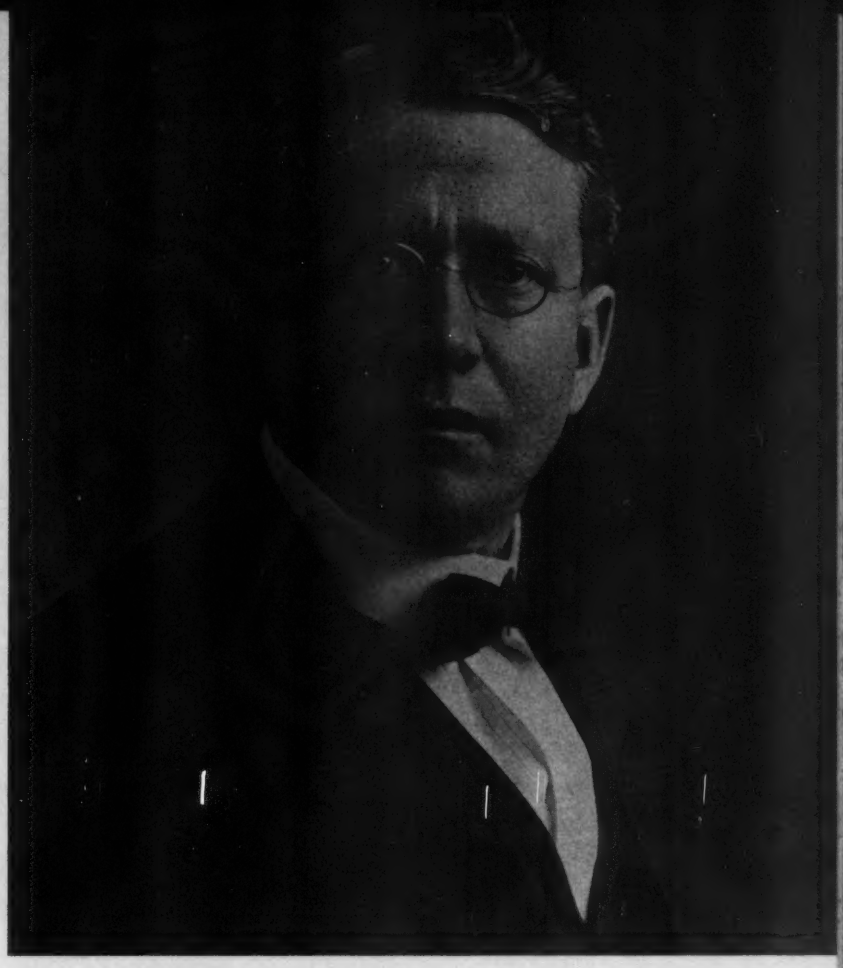
This is the first installment of the story of The Texas Co., and continues the series being presented by the California Oil World and Mitchum, Tully & Co., California investment dealers, on the companies making up the California oil industry of today.



This picture of Thos. A. O'Donnell was taken about 1910, when he was active in the oil business in and around Coalinga.

# The Texas Company, California

## Chapter I—Nativity—1893-1908

### By Eugene I. Harrington

When Colonel William B. Travis stuck his lone star flag in the pink adobe of Fort Alamo he captured the imagination of an entire country. There are vast differences between the growth of a country and the growth of an industry, yet in the story of the development of The Texas Company of California there is much of the same courage, spirit, and tenacity that the heroes of the Alamo displayed in their frontier stand a century and a year ago.

For almost a decade the lone red star of Texas has been a familiar sight to the millions of motorists who travel the smooth, broad highways of California. In this modern age of speed that star has a new significance; to the hard-driving motorists of today it is the symbol of the white, green and red service stations and streamlined trucks of the mighty Texas Company.

The average Californian is more than a little proud of everything that bears the name and mark of his state; he firmly believes that more often than not California products set the standard of quality for the world. Perhaps, on this account, Californians are sometimes inclined to consider The Texas Company alien, yet nothing could be farther from the truth. To be sure, that company is a part of the globe-girding Texas Corporation and it does bear the name of another state. But The Texas Company of California was born and bred on native soil; it is actually the outgrowth of a group of small companies that were founded nearly thirty years ago by California men on California soil.

Our story is not concerned with the Texas Corporation that started just after the turn of the century when the famed Spindletop gusher roared in and then under the paternal guidance of John W. (Bet a Million) Gates, grew until it had spanned the earth. Our interest lies more with the child than with its parent, and it shall be our purpose to tell the story of The Texas Company of California and how it grew to greatness on its own account. We shall concern ourselves with the men whose accomplishments are indelibly written across pages in Califor-

This picture, taken Oct. 12, 1895, shows a 1070-ft. O'Donnell and Whittier well being drilled for Silent and Calender. Mr. Silent is at the extreme left; Max Whittier is third from the left; Mr. O'Donnell is fourth from the left; Harry R. Calender is at the extreme right.

nia's oil history but whose parts in building the mature institution that became The Texas Company have not yet been recorded. We shall treat lightly with those whose works are well known to oil men but whose interests were so diversified that they belong more to the romance of petroleum than to the building of a single company. Such men were Edward L. Doheny, Charles Canfield, Dr. Norman Bridges, and J. C. Anderson; their achievements have often been told and our added testimony is not needed to insure their places in the sun. Rather, we shall relate the little known stories of Thomas A. O'Donnell, "Booky" Fuqua, Tom Crumpton, Jacques Vinmont, Clarence Olmsted and the others who took an equally important, though less heralded, part in laying the foundations and framing the structure of the dominant Texas Company of California.

• •

### A Village Grows Up

When, in 1893, oil was discovered in the front yard of a neat little home on the corner of Patton and West State Streets in residential Los Angeles the town seethed with excitement. Here, at last, was something tangible; here was the long-sought fuel and the needed industry that would attract solid citizens to sunny Southern California. For Los Angeles had had its fill of paper profits; just six years before, the city had learned the fickleness of fortune's smile. In the space of thirty months it had seen a boom strike with the violence of a tornado, it had felt the excitement of sudden prosperity and then had sat helplessly by and watched the bubble burst.

The city fathers of Los Angeles must have shaken sorrowful heads as they contemplated the debris left when the real estate boom of 1885 burst like a stuck bubble in their faces. It is even possible that they sadly admitted that "easy come, easy go" had its basis in fact. The Santa Fe and Southern Pacific railroads had taken care of the "easy come" part of the adage when they indulged in a bitter rate war that ended only after the price of a ticket from Kansas City to Los Angeles had been driven down to a dollar. Corn belt farmers, business men, adventurers and ordinary tramps had answered the beckoning call of a bargain and swarmed into the sleepy little pueblo by the thousands.

Hotels were jammed, tent villages sprang up, houses were purchased sight unseen and carpenters were at a premium as the building boom gained momentum. Everybody wanted land; and, as the demand grew, prices soared, two, three, and four hundred percent. Parades, brass bands, and free picnics added to the

general excitement and the regular inhabitants of the town, bewildered at first by the startling influx, threw themselves bodily into the frenzied land speculation.

A new mayor was elected on a platform of civic pride and Los Angeles began to spruce up. The plaza was changed from its primitive state to something more closely tuned to the times. Over the objections of old time Angelenos, the picturesque horse cars were replaced with new-fangled cable cars. Main, Spring, Broadway, and Hill Streets were transformed from rutted, dusty lanes to slickly paved thoroughfares. Housewives, bus boys, politicians and waitresses were making money, (at least that is what they fondly believed). Going into debt for these improvements didn't seem to worry the civic leaders in the least. It is not hard to understand why. In the two years from '84 to '86 the population had increased from 12,000 to 100,000; bank clearances had skyrocketed; freight carried by Wells, Fargo & Company had jumped from 300,000 to seven million pounds in a single year. By July, 1887, recorded real estate transfers had risen from practically nothing to $13,000,000 for the month.

Then came the rude awakening; the banks added the "easy go" tag to the adage by refusing to make further real estate loans. The boom ended as suddenly as it had begun, leaving a debt-ridden city, a disillusioned populace and, among other things, sixty "paper" towns in the surrounding countryside with 80,000 lots and only 2500 inhabitants. It was as though a scourge had hit the city; the special trains pouring into Los Angeles were empty and the outgoing coaches were packed to the doors. To those who remained, the exodus was an added blow to the hopes they held for the future. They would have felt more cheerful just then had they been able to realize that their sedentary village had been shaken awake and now, after a century of napping, was beginning to grow up.

Mr. O'Donnell and T. J. Crumpton on an American Petroleum Company lease in 1910.

### A City Fights to Live

By 1890 the population of Los Angeles had dropped to 50,000. The professional speculators and opportunists had been the first to leave and the new citizens of Los Angeles were a steadier, more serious lot. The deflation had been disappointing but these new settlers were imbued with the pioneering spirit and they were determined to carve out a place for their adopted city on the American scene. To the old-timers the taste of progress had been stimulating and when the first effects of the shock had worn off the two elements joined hands to gauge their city's possibilities. Los Angeles held out tempting offers of free land as a bait to Eastern industries and tried in every possible way to increase manufacturing and bring new payrolls to the city.

In their fight to live and grow the people of Los Angeles learned a lesson in the value of cooperation that they have never forgotten. It was in those trying times that their Chamber of Commerce was formed and the work that was to achieve amazing results in the next century was begun. They were to find out that it takes more than tourist trade to make a great city and they were to discover to their sorrow that abundant raw material, a mighty industry and cheap fuel were more important than weather, no matter how unusual. Of course, coal was available from Utah and New Mexico but high freight rates made it prohibitive for industrial use. Oil would have been a welcome substitute; its production in California was steadily increasing but the greater part of it was flowing into the Pacific Oil Company's refinery on San Francisco Bay. Citrus fruit was on its way but it had a long way to go before it could be classed as a major industry. Therefore, the finding of oil in the heart of Los Angeles was a gift from the gods; it in itself came close to providing the three things that the city required for continued growth. With its discovery, the first battle was won and the feet of Los Angeles were set in the path of spectacular progress.

### An Industry Changes a City

It can truthfully be said that the gaping hole that Edward Doheny and Charles Canfield dug during the spring of '93 changed the life and psychology of Los Angeles. When oil was struck 160 feet below the surface a new kind of excitement swept the town. This time men were willing to work for their riches, to dig patiently and hopefully for a black fluid that meant more to them than gold. Within a few months the search was in full swing. Machinery was rushed in,

These are the Crumpton and Fuqua families in an American Petroleum Company car, the picture being taken in Coalinga in 1912.

crude black derricks sprang up among the shrubs and flower gardens and the whole area was literally bathed in oil. To most of these men, hunting for oil was a new experiment; but in their amateurish way they somehow reached down into the earth and found what they sought. Before they were done they had sunk 1400 wells in the city of Los Angeles and had begun to make San Pedro harbor (or Rattlesnake Flats as it was contemptuously called in those days) into the greatest oil port in the world.

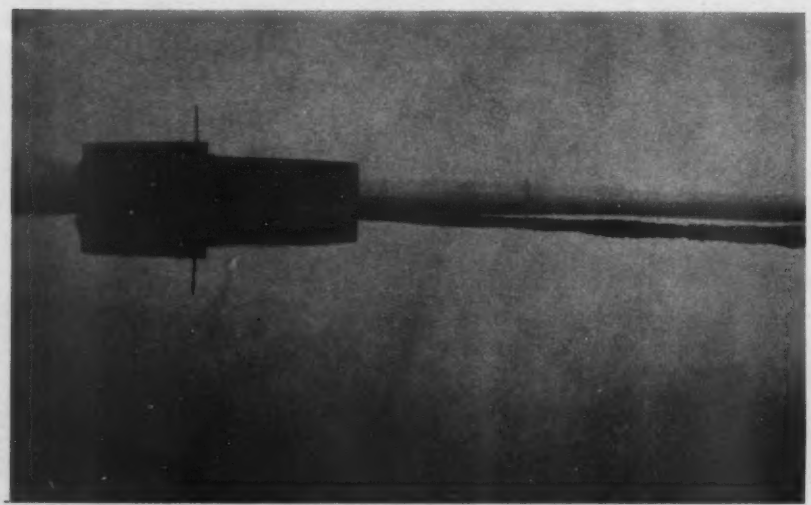
### Oil Men in the Making

Among the handful of experienced oil men who put down wells on every available inch of ground in the excited Los Angeles neighborhood was a burly, 23-year old Irishman with an enormous pair of shoulders and a ready wit. His name was Tom O'Donnell and he was destined to become one of the dominent figures in the oil industry of America.

O'Donnell had gained his first knowledge of oil in the fields of Pennsylvania; he had ben born and raised in those fields, selling newspapers in the streets of Bradford when that city was a boom town nearly sixty years ago. Oil was a part of him and in his youth he had resolved to follow it as a career. In 1889, four years before oil was found in Los Angeles, O'Donnell had come to California determined to make his fortune in the widely discussed but as yet undeveloped fields of the Pacific Slope. He had gone straight to Ventura where, in 1890, he secured a job as a roustabout with the Union Oil Company. Until 1893, when he came to Los Angeles, he served the Union Oil Company as a roustabout, pumper, tool dresser, and driller.

It was good luck that brought Tom O'Donnell to Los Angeles in the spring of 1893. The town was in a furor; everyone was talking, thinking, and dreaming oil and the husky, six-foot-four redhead was in his element. Expert drillers were rare and a man of O'Donnell's size, intelligence and enthusiasm was the answer to a leaseholder's prayer. It is not surprising that the men who had the foresight and courage to dig the discovery well sought out this enterprising young oil man and invited him to join forces with them.

In those early days Doheny and Canfield knew almost nothing about oil production but they were shrewd enough business men to recognize their strengths and limitations. Of one thing they were certain; it had taken them three months to dig their first 160-foot well and they realized that their discovery would be of little value to them unless they could put their producing activities on a sound and professional basis. Now, with sufficient capital and plenty of leased and optioned land, they needed only experience to insure success of their first oil venture. They pinned their faith on Tom O'Donnell and his drilling record of the next few years fully justified their judgment. O'Donnell and Max Whittier formed the firm of O'Donnell and Whittier, Drilling



This picture shows a lake of oil and the first storage tank under construction in Coalinga. In the background is the first well on the lease.

Contractors, in 1894, which did a large contracting business until its dissolution in 1899, finally acquiring interests in producing properties as well.

In 1901, Tom O'Donnell went to Coalinga, where he managed the Union Oil Company's business as well as operating on his own account. Years of hard work in the Los Angeles City field had increased his knowledge of petroleum a hundred-fold and out of that experience he had gained the respect of oil men all over California. When he arrived in Coalinga he was an acknowledged leader in the industry and it was not long before he had again demonstrated his practical knowledge of oil production. By 1908 he had acquired options for the purchase of large acreage in fee and went to E. L. Doheny for financing. Mr. Doheny furnished the funds and the American Petroleum Company was organized. Immediately following its formation O'Donnell became virtual head of the new $10,000,000 company, with the title of vice-president and general manager.

Thus the first unit of a group of sturdy companies that was one day to become The Texas Company of California was launched. Listed as owners on its logbook were some of the biggest names in California petroleum and at its helm stood a man who had come up through the ranks to a position of commanding leadership in the oil industry of the West.

Before the passing of many more months four other California companies were to be launched and take their places alongside the flagship of the fleet. These were the Niles Lease Company, American Oilfields Company, Midway Oilfields Company, Ltd., and Midland Oil Company. Their beginnings, struggles and final consolidation into the California Petroleum Corporation (which was to become The Texas Company in 1928) shall be the subject of the chapter that is to follow.

## A. P. I. Issues New Specifications

The A.P.I. has issued revised specifications for rod and tube type, cold drawn pumps, locomotive type boilers, and belting. The new specifications are available at small cost from the Institute.

The committee on standardization of the Institute has issued specifications for steel flanges and flange unions. The specifications provide interchangeable ring joints for American (A.S.A.) steel flanges threaded with A.P.I. standard line pipe threads, or American standard threads, other sizes of flanges as required, and rolled and slip-on welding and welding neck flanges. The ring joint dimensions are also to be used on steel flanged valves and fittings connected to ring joint flanges, or where ring joints are required in piping connections.

## Elba Oil Swabs Water In Watsonville Well

South of Watsonville in sec. 6, 13-2, the Elba Oil Co. cemented 8⅝-inch casing at 3870 ft. and swabbed with the hole open to bottom at 3971 ft. but got water only.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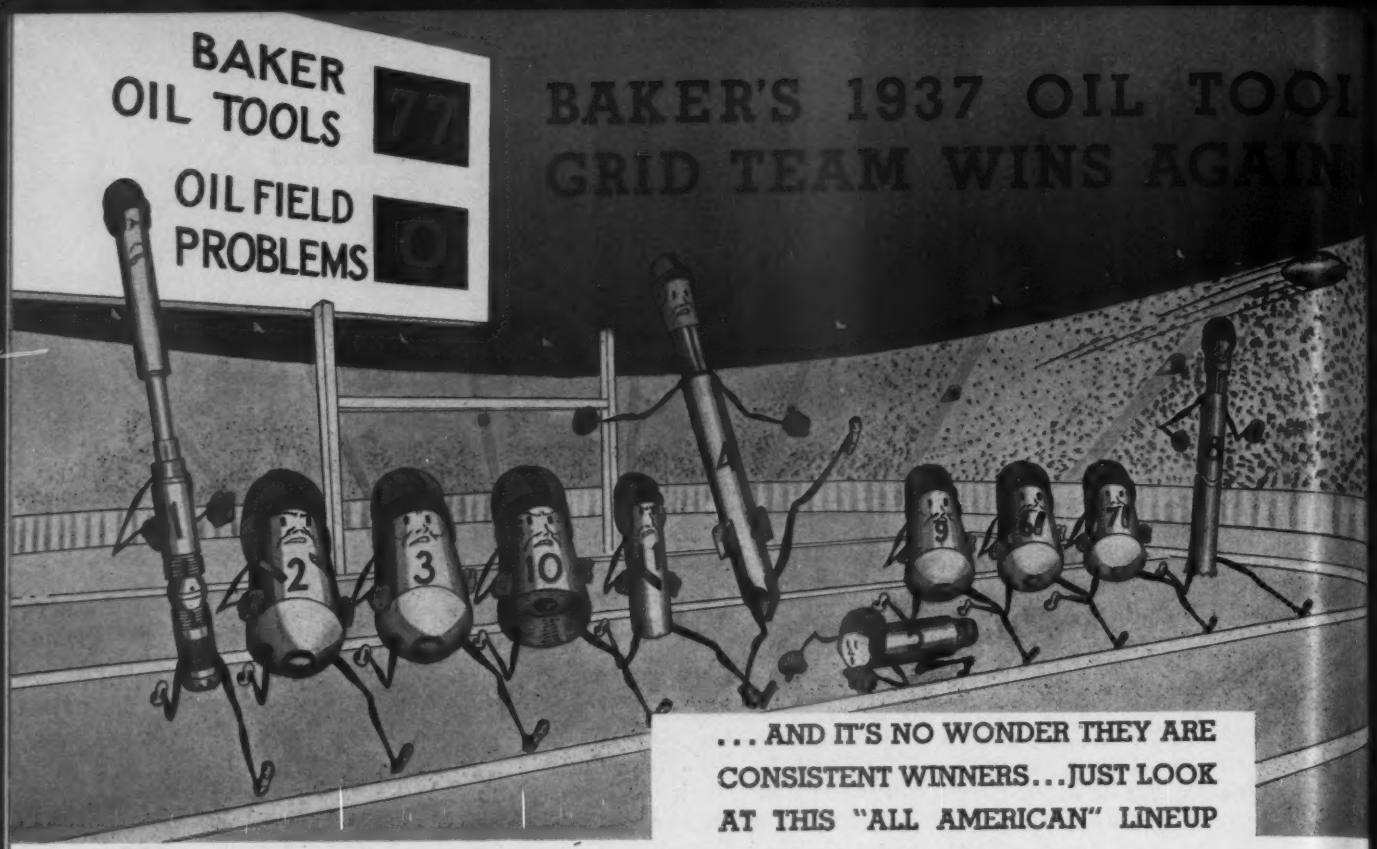


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| NO. | POSITION | PLAYER | REMARKS |
|---|---|---|---|
| 1 | Right End | Baker Cement Retainer | Gave wonderful performance all year. Unequalled for difficult "plays" such as Squeeze Jobs; Recementing; Shutting Off Bottom Water; Cementing Behind Sections of Pipe; Plugging Back to Upper Zones; Testing Upper Cased Formations. |
| 2 | Right Tackle | Baker Cement Whirler Float Shoe | This boy's really the ultimate in cementing efficiency. It's those side ports that give him the edge. They direct the cement slurry in a whirling mass up and around the shoe and casing with little danger of channeling. |
| 3 | Right Guard | Baker Regular Cement Float Shoe | A fine defensive player that can always be depended upon to safely guide, float and cement the longest and heaviest string of casing. Has the 3 Baker Features of: 1, Strength; 2, Valve Efficiency; 3, Drillability. |
| 4 | Full Back | Baker Rotary Wall Scraper | This player has never been known to fail in his duty. Is safe, dependable and performs a number of jobs with equal efficiency. Also famous for his amazing expansion range. |
| 5 | Center | Baker Bakwik Model "B" Drill Pipe Float | Nothing gets by this boy when he is in the drilling string. His valve action is quick and positive. He also is proud of the fact that his entire valve assembly is merely dropped into place without the aid of wrenches or special tools. |
| 6 | Left Guard | Baker Cement Wash-Down Whirler Guide Shoe | A newcomer to the Baker line who is proving extremely popular. Is designed to facilitate landing of casing where bridges or other formation obstructions are likely to be encountered. |
| 7 | Left Tackle | Baker Cement Wash-Down Whirler Float Shoe | Is a brother of the Baker Cement Wash-Down Whirler Guide Shoe, only this boy has a float valve in addition to a plain guide. For some jobs he is considered more efficient than his brother. |
| 8 | Left End | Baker Cable Tool Core Barrel | Here is a player that is extremely popular with cable tool operators. Reason: Takes accurate uncontaminated cores and is easy and economical to operate. |
| 9 | Left Half | Baker Cement Guide Casing Shoe | An old timer in the Baker lineup. Is a strong, safe guide shoe with internal construction of *drillable* Baker-Formula Concrete. |
| 10 | Right Half | Baker Cement Float Collar | The running companion of the Baker Cement Guide Casing Shoe. An efficient float valve that relieves strain on derrick and equipment and provides added safety in case the pipe is dropped. Also serves as a stop for the cement plug. |
| 11 | Quarter Back | Baker Whirler Cementing Collar | One of the key men in the Baker lineup. Provides an efficient, economical method of cementing at any desired depth in the casing. (Usually used with Baker Metal "Petal" Basket). Has same efficient whirling action as Baker Cement Whirler Float Shoe. |

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# Union Kernco 34-1 Shows New Valley Prodctive Area

**Well completed from 11,240 to 11,295 ft. in new productive horizon. Initial production rate 2400 bbls. per day.**

New and apparently prolific light oil reserves in hitherto unproductive territory five miles northeast of Rio Bravo, and 25 miles northwest of Bakersfield, have been uncovered by Union Oil Co. in its K.C.L. 1-34 deep test in sec. 34, 28-25, completed early this month after 221 days of drilling. The pay zone was topped at 11,240 ft. and a core of 55 ft. of well-washed, highly porous continuous sand was taken down to 11,295 ft. The structure is identified as the Rio Bravo sand by Union Oil Co. geologists.

### Spacing Program

The location of the test well was carefully chosen to conform to a definite spacing program, allowing one well to 20 acres and staggering the locations in a manner similar to that now in use at Kettleman Hills. The actual location is 330 ft. south and 330 ft. west of the northeast corner of se¼ sec. 34, 28-25. Elevation of the derrick floor is 336.8 ft.

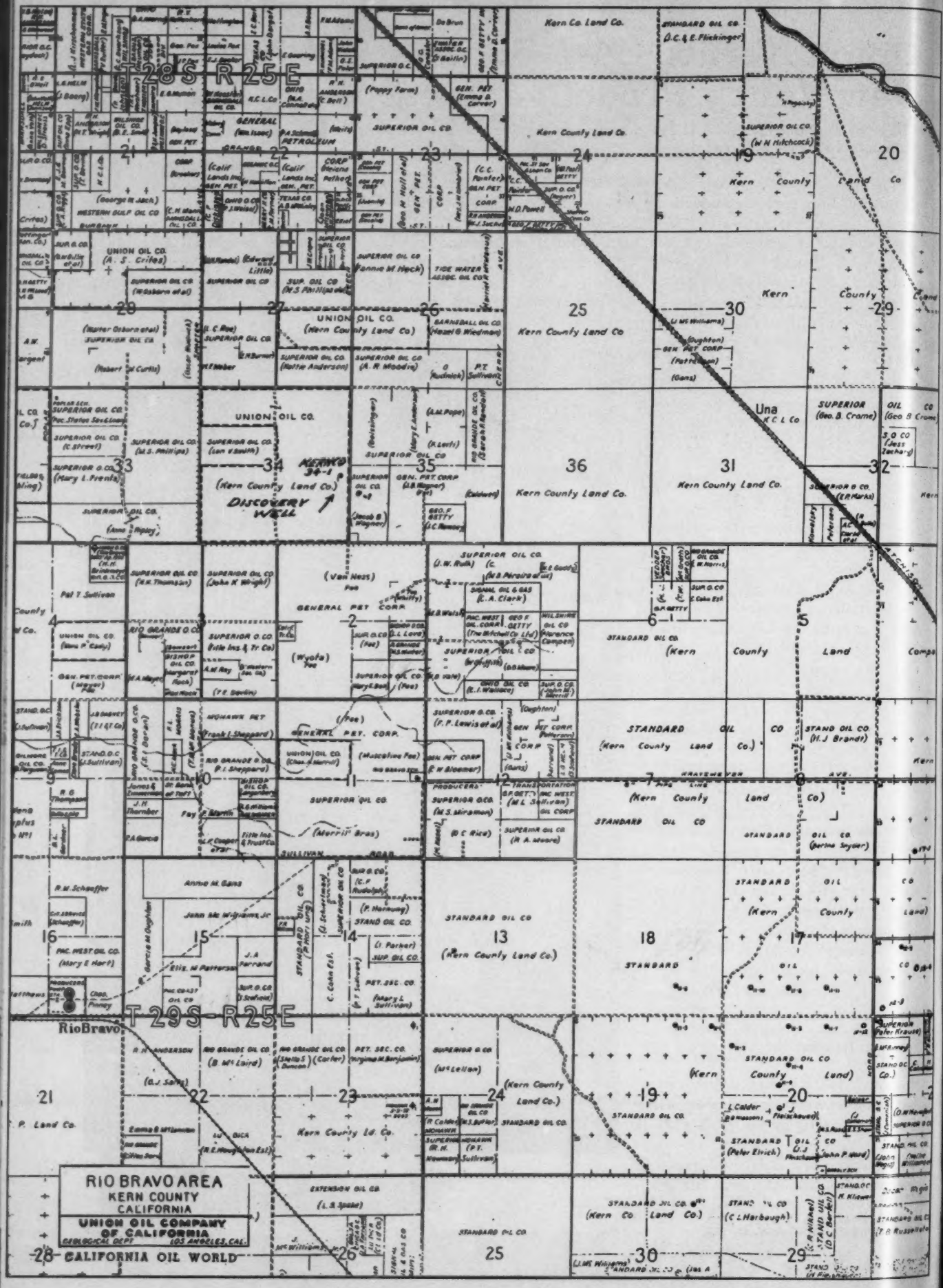
The discovery well was spudded in Mar. 29, 1937, and completed Nov. 4, for an initial flow of 2400 bbls. a day of 39.6° A.P.I. oil through a 40/64 in. bean. Tests have indicated that the potential production should be between 7000 and 9000 bbls. daily. On November 17, it was beaned down to 20/64 in., and was producing 1666 bbls. a day, with 2175 pounds tubing pressure and 2149 pounds on the casing. The well also produces about 1,307,000 c.f. of gas.

### Distinct Structure

Although the Rio Bravo discovery is along the same general structural trend as the Greeley field, it is probably on a distinct structure, according to Earl Noble, chief geologist of the compnay, and will stimulate development of the flat alluvium covered area in the southern part of the San Joaquin Valley. Mr. Noble, upon whose recommendation the land was leased by Union Oil Co., has believed persistently in the production possibilities of this area since 1924, when a well was drilled to a depth of 6053 ft. a mile and a half from the site of the discovery well on presentations he made as the result of a topographic survey.

The discovery site is well out from the foothills in a relatively flat area with little noticeable topographic relief other than a few low gentle swells that in general trend in a northwest southeast direction. The area is completely covered by a thick mantle of alluvium and the

Ponderous equipment is needed to tap prolific pay zone discovered far below the Greeley formation.


T 28 S R 25 E
T 29 S R 25 E
DISCOVERY WELL
KERN 34-1
RIO BRAVO AREA
KERN COUNTY
CALIFORNIA
UNION OIL COMPANY
OF CALIFORNIA
GEOLOGICAL DEPT LOS ANGELES, CAL.
CALIFORNIA OIL WORLD
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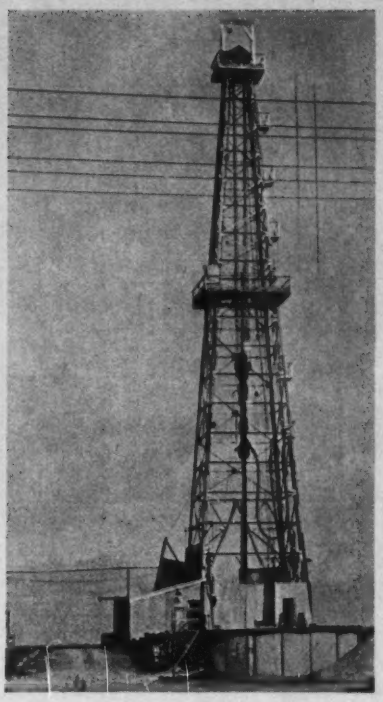
Una
RioBravo

Earl Noble, chief geologist, and Jack Reed, Valley division drilling foreman, studying a core sample from Union's important discovery. At right is shown the new deep zone light oil producer.



little that is known of the subsurface geology has been gathered from the few scattered deep wells in this part of the valley and from seismograph studies carried on during the last few years. The broad gentle surface swells give some indication of the possible structure in the Pliocene, but until very recently practically nothing was known of the structural conditions in the Miocene.

During the last two years great strides have been made in interpreting the Miocene structure and the seismograph has been a great aid to the geologist in this work. Such discoveries as the Ten Section and Greeley fields have added greatly to our understanding of the Miocene structure in the flat part of the Valley, but the importance of the recent discovery of the Union Oil Co. cannot be overestimated since it definitely established the presence of prolific production at depths in excess of 11,000 ft., and suggests that production can be obtained as deep as unaltered sedimentary rocks exist under favorable structural conditions.

### Sub-Surface Survey

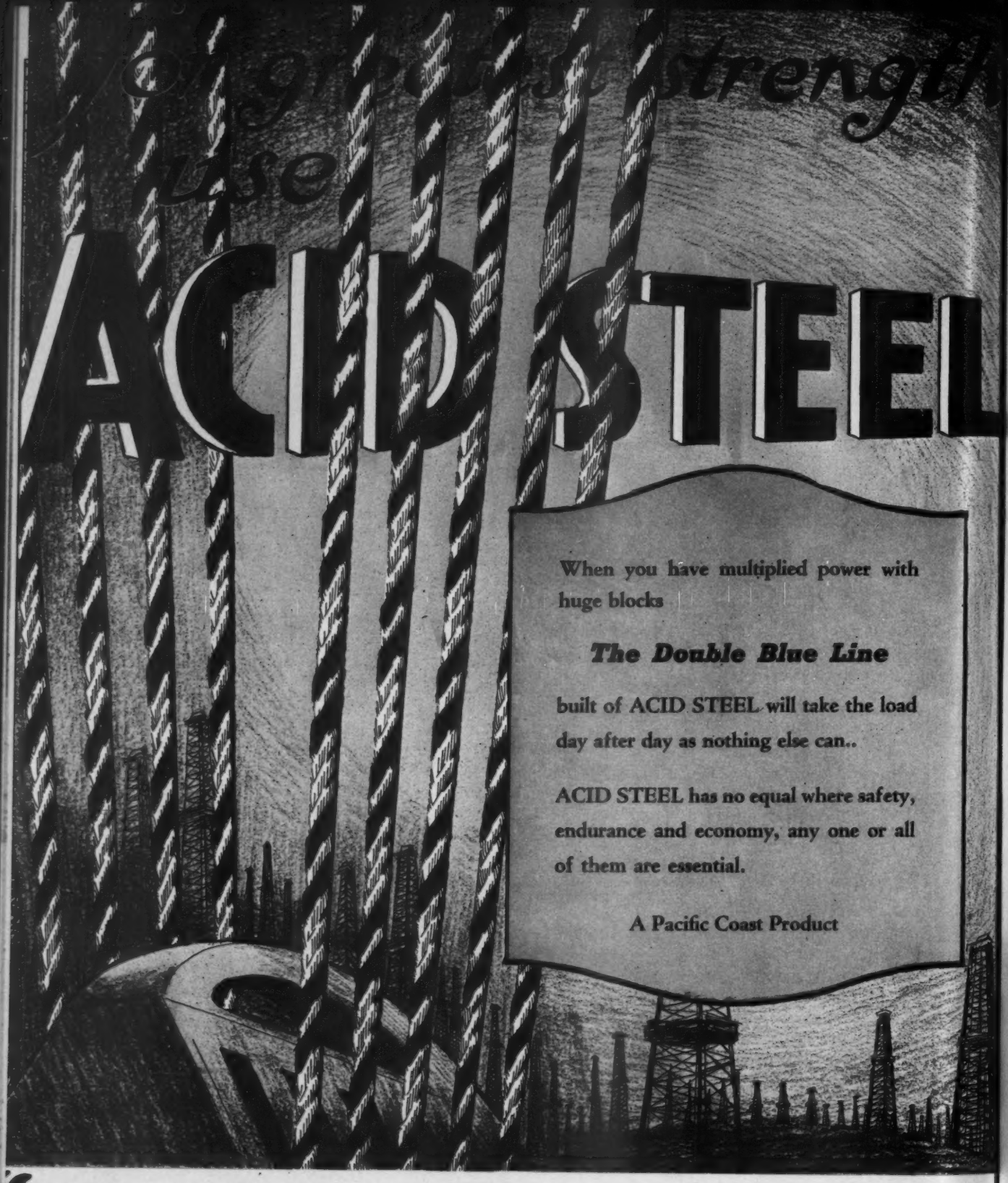
The seismograph played an important part in the Union's discovery, but topography led the Union geologists to suspect favorable structure here, and much of the land held by the company was taken along what appeared to be a general structural trend. However, the actual location was made from an interpretation of seismograph records, based on an horizon approximately equivalent to the top of the Greeley producing zone.

Drilling was under the direction of Jack Reed, Valley division drilling foreman. At 10,800 ft. the deviation is only one quarter of a degree, and the deviation for the 11,302 ft. depth is never greater than two degrees. At depths below 11,000 ft. there was a tendency for the mud to lose water and pack, due to the weight of the mud column forcing water from the bottom layers into the formation. This problem was solved by periodic mud changes and indicates a source of future deep well drilling trouble that should be studied.

This field may be and probably is along the same general structural trend as Greeley, but it appears to be a definite and distinct structure. The main significance of the discovery is the fact that sand of such high porosity and good permeability is found at this depth. Tests on the cores from the 55 ft. interval showing a porosity of 25% and about 500 mldys. definitely established the fact that commercial production can be obtained at great depth and that this sand will play an important part in the future development in the flat and alluvium covered area in the southern part of the San Joaquin Valley.

### Drill Samples

Ditch samples were taken continuously during the drilling of the upper part of the hole and the top of the Mulinia zone was picked up by this method at 3793 ft. Coring was started at 4500 ft. and continued at intervals to 6000 ft. Coring was continuous from 6000 ft. to 6600 ft., and the well then drilled ahead to 7300 ft. From this point to the top of the Miocene, cores were taken at fairly regular intervals (usually upon drilling a bit). The top of the Miocene (Reef Ridge) was picked up at 7620 ft. Down to this point the only dips noted were practically flat. With the exception of a drilled intervals from 7905-8100 ft., the entire interval from 7800 to 9000 ft. was cored continuously.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The top of the McClure shale was picked up at 8000 ft. and a few oil and gas shows were noted in the shale between 8130 and 8558 ft. Dips in this interval varied from 0° to 7° but averaged about 4°.

A few stringers of oil sand occurred immediately below 8559 ft., and in one place there was as much as two feet and three inches in one body. These streaks gave an amber colored cut and had a kerosene odor.

At 8690 ft. the top of what is apparently the equivalent of the Greeley sand was encountered. This consisted of brownish siltstone with occasional thin lenses of fine sand. Oil occasionally showed in the shale along bedding planes, or in the fractures of the more cherty portions. A thin streak of bentonite occurred at 8901 ft. The top of the Lower Fruitvale was picked up at 8902 ft. This interval consisted of brown to black shales with occasional streaks of green bentonitic clay. A few spots of oil were noted in the more cherty parts. Dips varied from 2° to 10°, with the average around 4° to 6°.

### Dips Low

The top of the Valvulineria California Zone (Round Mountain Silt) occurred in an uncored interval between 9654 ft. and 9787 ft. The top of the zone was estimated at 9575 ft. and consisted of a hard, dark brown shale with abundant forams and some carbonaceous material. The top of the Valvulineria Robusta Zone also occurred in an uncored interval between 9795 ft. and 9889 ft. and the top was estimated at 9800 ft. The zone consisted principally of poorly to well bedded brown to black clay shale with occasional cherty shale and a very hard silty shale.

### Other Possibilities

In general, the observed dips were low in this interval, although in one or two places, local dips as high as 12° to 18° were noted. A very hard sandstone was encountered at 10,269 ft. The sand was very silty and apparently had very little porosity. A few slight straw-colored cuts were obtained in the sand interval which occurred from 10,269 ft. to 10,318 ft. Another sand was encountered at 10,366 ft., and it is possible that this sand is the equivalent of the Olcese sand. Approximately 65 ft. of this sand occurred between 10,366 ft. and 10,500 ft., with a fairly solid body of 58 ft. at the top and two other streaks at four feet and three feet below. The sand was fine, brownish-gray, firm but friable, and gave good amber-colored cuts that had a fair petroleum odor. The top of the sand appeared rather silty and the cuts were fairly light, while the lower part of the sand gave better cuts, and appeared to be somewhat more porous. While the possibilities of the sand were questioned, it still justified testing. A string of 6⅝-in. casing was cemented at 10,248 ft., and a series of formation tests were run to test both the shut-off and the possibilities of the sand. The results of these tests were not conclusive. They indicated that the sand might not be productive in this location, but on the other hand, there is some reason to believe that the test is not a fair indication of the capabilty of the sand, and that it might be a source of some future production in this area. The sand, however, lacks the porosity and high saturation apparent in the deep sand. With the exception of one or two very thin streaks of oil stained sand, the only other saturated sand found between this sand and the Rio Bravo sand was about seven feet of medium to coarse oil sand in a core from 10,828 ft. to 10,843 ft. This sand had a good odor and fair cuts.

### Reach Pay Zone

The top of the Rio Bravo sand was encountered at 11,240 ft. and as soon as this sand was entered, there was no doubt that the well had encountered a promising zone. Fifty-five feet of solid oil sand were cored from 11,240 to 11,295 ft. This sand was well washed and very porous. The top of the sand was gray, with good odor, and gave a few light cuts. However, the cuts grew stronger with depth and the grayish sand took on a more brownish tinge. The bottom of the sand gave excellent dark-colored cuts and a very strong, sharp gasoline odor. One core was taken below the 55 ft. of sand and consisted of seven feet of gritty siltstone, and although this siltstone had practically no porosity, it still showed considerable gas while wet. It appeared probable that there would be no danger in coring ahead and that additional oil sand would be encountered. However, the 55 ft. of sand looked so good that it was thought advisable to make a test at this interval before going ahead. It was decided to set an aluminum liner so that if production was not satisfactory, the liner could be drilled and the well deepened.

### Potential Estimates

When completed the well flowed at a 2400 bbl. daily rate though a 40/64-in. bean with 1500 pounds on the tubing pressure and 1700 pounds on the casing pressure. The gravity of the oil was 38.7° A.P.I. with a cut of 0.1%, and the well was making about 2000 mcf. of gas. The bean was immediately reduced to 8/64-in. which in turn reduced the flow to 1400 bbls. daily with 1950 pounds on the tubing pressure and 2000 pounds on the casing pressure, the oil tested 39.6° gravity, and the gas, 1,260 mcf. The well remained shut in until pipe line connections could be made to the Rio Bravo pump station about three and a half miles south of the well. The well has never been opened up, but some experimenting has been done with the bean, and considering the high pressure and the small drop in pressure for a relatively large increase in production, it is certain that the potential of this well is far in excess of the 2400 bbls. daily rate established on the initial test. The best estimates available seem to indicate that if opened up, the well should produce somewhere around 7000 to 9000 bbls. a day, but since the well is now producing barefoot, it is probable that it will not be opened up to capacity.

# K. R. Kingsbury, Standard President, Dies

K. R. Kingsbury, president of the Standard Oil Co. of Cal. since 1919, died early in the week on the Grace liner Santa Paula, en route through the Panama Canal.

Mr. Kingsbury died apparently from a heart attack while dressing for dinner.

His career, which latterly has included many other activities in addition to those in connection with his position as president of the Coast's biggest oil company, has been one of outstanding civic as well as business leadership. He took leading roles in Community Chest campaigns, in statewide promotional activities, and in charitable work, and was chairman of the finance committee of the Golden Gate International Exposition and one of its four-man board of management.

Probably the best insight into the man's character can be obtained from a brief biography made of him by the Standard Oil Bulletin of May, 1919, when he became president of the company. The article said:

"Born in Columbus, Ohio, in 1876, our new chief is one of the youngest of the Standard Oil presidents. Graduated from Princeton University in 1896, he took a year of post graduate work in mining engineering at Columbia. His Standard Oil connections date from Dec. 27, 1897, when he did pipe line construction work in Pennsylvania in which state he also served as oil gauger for two and one-half years at the Millway Pumping Station. His field work then ended and he was transferred to the Accounting Department at 26 Broadway and then to the sales department. For about two years he sold candles, greases and other specialties in Jersey City, Hoboken and Bayonne, and later, lubricating oils and greases exclusively in North Carolina and Washington, D. C. These details illustrate Standard Oil training and how Standard Oil executives are made.

"In 1903 he returned to New York for duties in the lubricating department of the home office. In 1906 he became agent of the Standard Oil Co. (California) at New York and later assistant to the president of that corporation at 26 Broadway.

"At the time of the dissolution of the Standard Oil Co. of New Jersey in December, 1911, Mr. Kingsbury was elected second vice president of the Standard Oil Co. (California) and in June, 1912, closed out the New York office and came to California. Two years later, he became a vice president and was elected president last month."

## B. D. Balthis

The Chairman of the Program Committee of the California Natural Gasoline Association started his career in the industry as an employee of the Union Oil Co. gas department as gas tester. In 1922, he left the Union Oil Co. to become interested in the Apex Engineering Co. and in 1924, as a co-partner, started a new venture, the Natural Gas Equipment Co., which later was incorporated and of which he is now a Vice President. Mr. Balthis completed his education at Stanford University and served overseas in the Engineers Corps of the Rainbow Division. In the program for the 12th annual Fall meeting of the association he set up a mark which future chairmen will find difficult to equal.

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# CNGA

# November, 1937

This section, a regular monthly feature of the California Oil World, is devoted to the activities of the California Natural Gasoline Association. The California Oil World is the exclusive official publication of the California Natural Gasoline Association, so designated by vote of the Association Executive Committee in a meeting on August 19th, 1937

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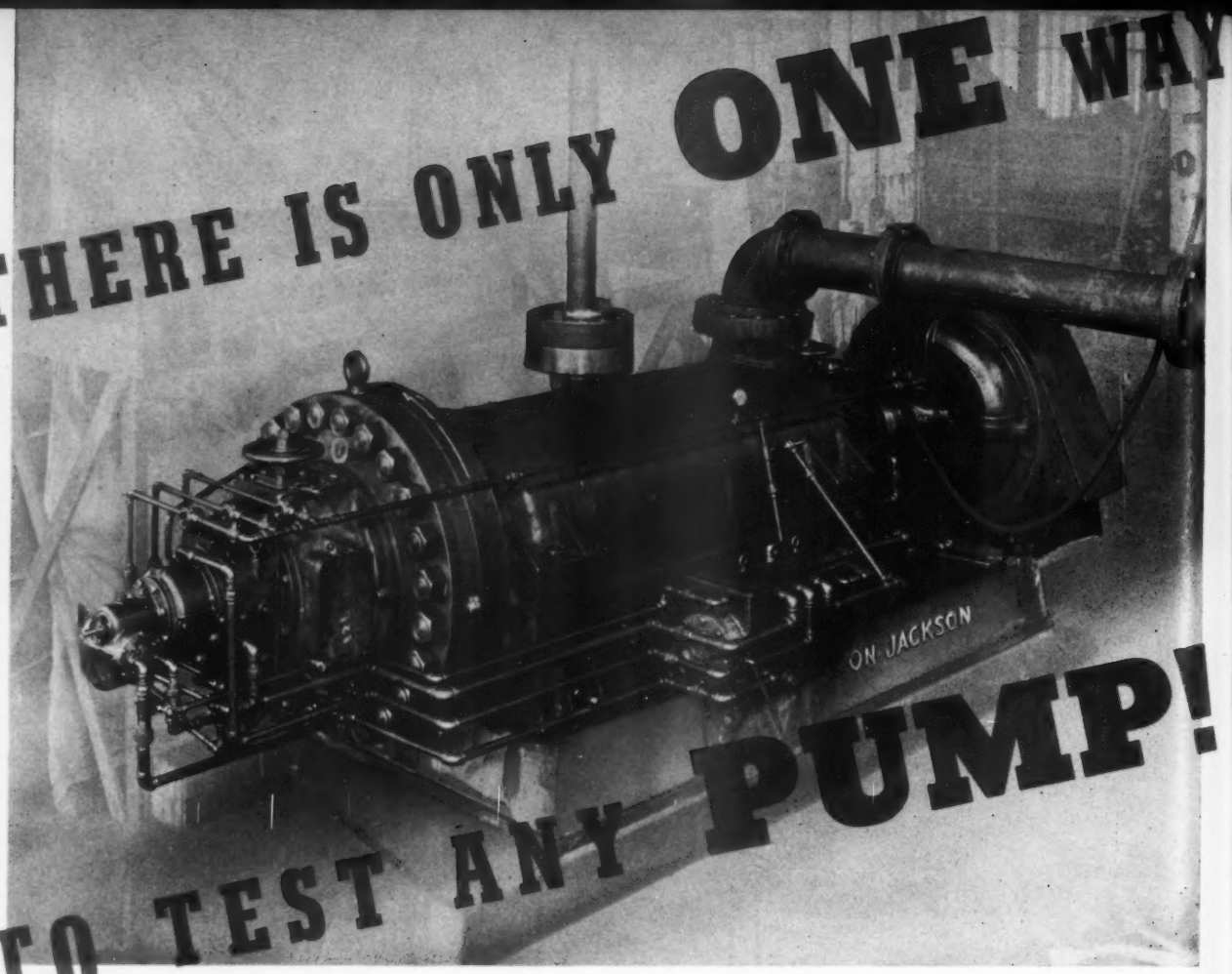


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# Status of Polymerization In Natural Gasoline Manufacture

By HENRY N. WADE
At C. N. G. A. Fall Meeting

During the past two years several papers have been published bearing on the practical operation of polymerization processes; however, much of this material has been prepared for the purpose of advocating one or another of the commercial processes now available. Much of it is also confused, from the standpoint of the natural gasoline manufacturer, by being based on "combination" operations, in which light products from oil cracking make up part of all of the feed to the polymerization unit.

The purpose of this paper is to present, in an entirely general and disinterested way, information regarding the present state of the polymerization art as applied to the conversion of the light materials which can be derived from stabilizer discard in the ordinary natural gasoline plant. From the standpoint of the natural gasoline plant owner, I will attempt to answer the following questions:

1. What is the general purpose of polymerization?
2. What commercially successful processes are now available?
3. How do they operate?
4. How much and what do they produce?
5. What is the plant investment cost?
6. What is the operating cost?
7. Under what conditions will a polymerization plant pay?

### General Purpose of Polymerization

The general purpose of polymerization is to at least partially conserve for use as motor fuel the materials in the stabilizer discard, which in many natural gasoline plants are either wasted or else used for low-grade fuel purposes. By the polymerization operation the butanes, and to some extent propane, are partially converted into liquids having a normal gasoline boiling-range, and which consequently can be economically stored and handled with normal facilities.

In addition to conserving materials which might otherwise be wasted, it has been found that polymerization produces fuels having uniquely valuable properties, which will be discussed in the answer to question 4.

Henry N. Wade

### Commercial Processes Available

Two general types of plant are in commercial use; the straight heat-pressure-time type plants and plants in which a catalyst is used to assist in the conversion.

The "Unitary Thermal Polymerization Process" is representative of the first type; this process is owned and licensed by Polymerization Process Corp. through its licensing agent, M. W. Kellogg Co. This process was developed jointly by Phillips Petroleum Co., Standard of Indiana, Standard Oil Development Co., The Texas Co., and M. W. Kellogg Co. The first commercial plant using this process is at the Alamo refinery of Phillips Petroleum Co. at Borger, Texas. This plant began successful operation around 1933, and has been increased in capacity several times since then. Operations of this plant are discussed in an article by J. S. Carey in the December, 1936, issue of the "Refiner and Natural Gasoline Manufacturer".

It is obvious that many modifications of this type of operation are possible, depending both upon the nature of the raw feed and upon the nature of the final products desired. One such modification is described in an article by Ridgway, Wagner and Swanson in the November 4th, 1936, issue of "National Petroleum News".

The Dubbs Catalytic Process, is, so far, the only commercial application of a catalytic process. This process is owned and licensed by the Universal Oil Products Co. The first commercial plant using this process for converting straight natural gasoline plant stabilizer discard was placed in operation in March this year at the McKee gasoline plant of the Shamrock Oil and Gas Corp. in the north Texas Panhandle.

### Schemes of Operation

In order to make a heavy, gasoline-range hydrocarbon out of the light raw materials, propane and butane, it is obviously necessary to induce two or more molecules of the light materials to join together, forming a new molecule containing more than three or four carbon atoms, and consequently having a higher boiling point than the original propane or butane. Unfortunately, the propane and butanes extracted from natural gas belong to the "saturated" or paraffin series of hydrocarbons, and are very inert chemically. On this account, no direct method has yet been discovered for making the light paraffins combine together to form heavier ones.

However, it has been found that by subjecting the light paraffns to heat and pressure for a suitable length of time, they are broken down into other types of hydrocarbons which are "unsaturated", or contain more carbon relative to hydrogen than do the paraffins, and which are relatively active chemically. The light unsaturated compounds so produced can then be made to combine with each other to form heavier compounds, either by a suitable continuation of the heat-and-pressure treatment, or by the use of a catalyst.

Endless numbers and kinds of products may be produced by the initial breaking-down step, depending upon the degree of the heat and pressure applied, and the time duration of the treatment. Likewise the nature of the products of the final recombination may be widely varied by the same factors.

Without going into the almost infinite mass of possible reactions which can and do take place, I will present one set to illustrate the general idea. (Table No. 1.)

This is not intended to represent even a small part of the reactions which actually do take place; some idea of the tremendous complication of these may be gained from the fact that an analysis of

**TABLE 1**

**BREAKING DOWN STEP**

Feed — Propane $C_3H_8$ (Saturated) + H,P,T = Ethylene $C_2H_4$ (Unsaturated) + Methane $CH_4$

— Butane $C_4H_{10}$ (Saturated) ±H,P,T = Propylene $C_3H_6$ (Unsaturated + Methane $CH_4$

**POLYMERIZING STEP**

Ethylene $C_2H_4$ + Propylene $C_3H_6$ ———— = Pentenes $C_5H_{10}$

Approx. Boiling Pt. 92°F. — Sp. Gr. 0.65

Or

Propylene $C_3H_6$ + Propylene $C_3H_6$ ———— = Hexenes $C_6H_{12}$

Approx. Boiling Pt. 130°F. — Sp. Gr. 0.72

the total final products of an operation will show everything from hydrogen gas to extremely heavy tars.

Both the straight thermal process and the catalytic process, then, use the initial heat-pressure-time step for converting the paraffin feed stock more or less completely into unsaturates. In the simple thermal process the conversion of the light unsaturates into heavy ones is accomplished along with the initial breakdown in one operation; in the catalytic process the conversion is partly accomplished by treating the fractionated products of the breakdown with a catalyst. In both processes the final step consists of fractionating out the undesired products, to yield a final liquid product of the desired boiling range. Both processes also require some recycling of materials in the thermal stage, since the reactions do not carry through to completion in a once-through process. The recycle material is derived from the fractionation following the primary conversion, and is made up of the unconverted paraffins and some of the unsaturates which are too light to retain in the final product.

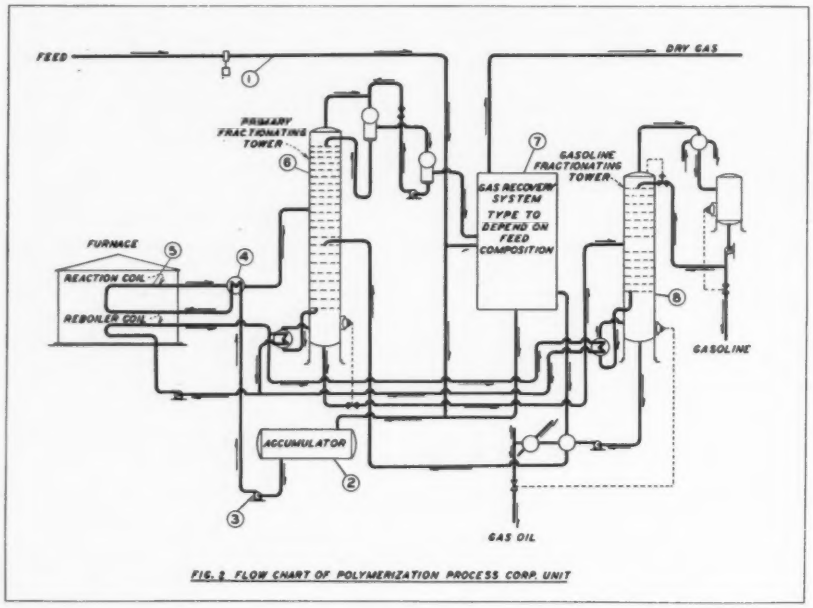



FIG. 2 FLOW CHART OF POLYMERIZATION PROCESS CORP. UNIT

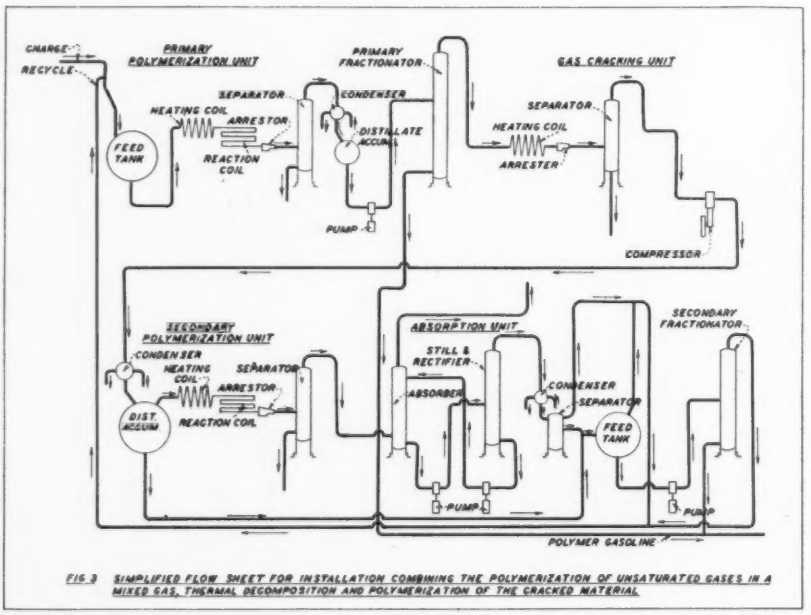



FIG. 3 SIMPLIFIED FLOW SHEET FOR INSTALLATION COMBINING THE POLYMERIZATION OF UNSATURATED GASES IN A MIXED GAS, THERMAL DECOMPOSITION AND POLYMERIZATION OF THE CRACKED MATERIAL

Fig. 2 shows a flow-sheet for the Unitary Thermal Process. The feed, consisting of stabilizer discard in liquid form, enters through line (1), and together with the recycle stock, flows to storage tank (2). Pump (3) delivers the liquid through feed exchanger (4), through the reaction coil (5) in the tube furnace, and into the fractionator (6).

In this fractionator all materials which are too light for use in the final product, including the unconverted propane and butane, are taken overhead and delivered to the "gas recovery system", (7), which can be of any suitable type, such as an absorption or compression unit.

The recovery system separates and discards to fuel all material lighter than ethylene, and makes two liquid products; one consisting of unconverted propane and butane and the corresponding $C_3$ and $C_4$ unsaturates, and the other consisting of the heavier unsaturates which can be used in the final product. The first of these joins the incoming raw feed for recycling. The heavier product is fed to the primary fractionator below the feed tray, where it largely mingles with the bottom product from the column.

The bottoms from the primary fractionator are fed to the gasoline fractionator (8), where the materials within gasoline boiling range are taken overhead and condensed to make the final product. The heavy materials are withdrawn from the bottom of this column, for use as gas-oil or fuel oil.

Fig. 3 shows one of the many possible modifications of the above system; in this case designed for making special products. Here the feed is put through a primary polymerizing step, and the gases produced in this step are cracked, put through a second polymerization unit, and the products are finally fractionated and partially recycled through an absorption recovery system.

Fig. 4 shows the flowsheet of the Dubbs

process plant of the Shamrock Oil and Gas Corp.

The raw feed of fractionated butane first enters the storage tank (1) and is pumped by the feed pump (2) through the butane cracking furnace (3). Operating temperatures through the tubes of this furnace range from 1000° to 1150° F., with pressures ranging from 800 pounds to 1000 pounds. The primary breaking down and partial re-combination steps occur in this furnace, the time element being provided by a large group of tubes on the outlet side of the furnace.

From the cracking furnace the material passes in vapor form through reboiler exchanger (4) to the vapor cooler (5), and thence to the debutanizer column (6).

In the debutanizer column the primary separation is made between the heavy polymerized material formed in the cracking furnace and the light materials which require further polymerization in order to get them down within gasoline boiling range. The reboiler heat required for the operation of this column is secured by re-circulating liquid from the bottom of this column through a part of exchanger (4) and back into the bottom of the column, by means of reboiler pump (7). The top temperature of the debutanizer column is controled through a conventional reflux circuit, so as to take overhead only those materials which are too light to retain in the finished gasoline. This light material leaves the column through transfer line (8), which carries it to the strictly catalytic part of the system.

The first step in the catalytic treatment of these vapors consists of heating them to a controlled temperature. This is done in the butane vapor heater (9). The heated vapors then pass to the group of catalyst towers (10). These towers are arranged so that the vapors pass downward through three of them in series, the 4th tower being available for regeneration while the other three are in operation. The piping and valves are so arranged that each tower in turn can be used for the first admission of the hot vapor; in this way the operation of the towers can be rotated so that the tower containing the most highly spent catalyst can be taken out of service when the freshly regenerated tower is put into service.

From the catalyst towers the material, still in vapor form, passes through condenser (11) into distillate receiver (12). The liquid condensate is pumped by charge pump (13) into depropanizer column (14), where materials lighter than

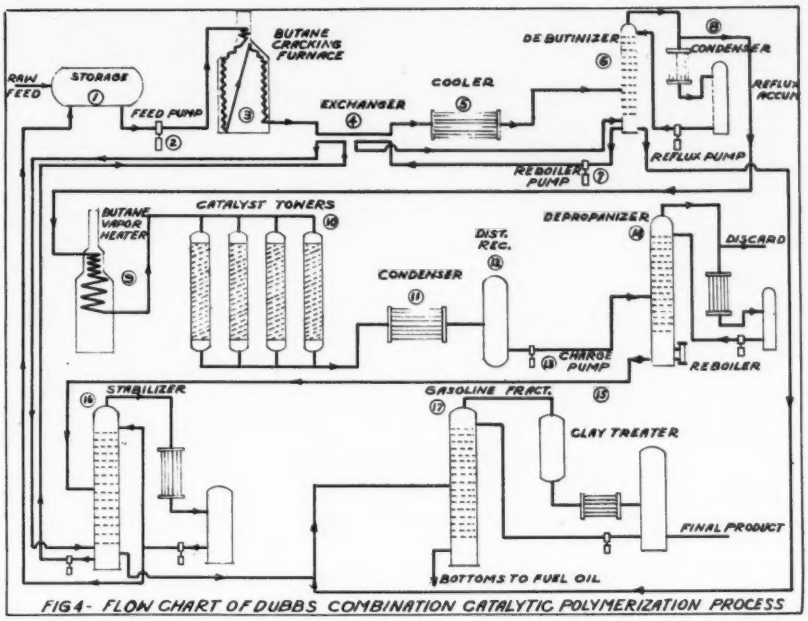



FIG 4 - FLOW CHART OF DUBBS COMBINATION CATALYTIC POLYMERIZATION PROCESS

butane are separated from the product and are discarded. This column is refluxed in a conventional manner; reboiler heat is supplied by steam.

The bottoms from this column pass through pipe (15) to stabilizer column (16), where materials too light to retain in the finished gasoline are taken overhead and returned to storage tank (1) for recycling through the entire process.

The bottoms from stabilizer (16) and the bottoms from debutanizer (6) combined run to gasoline fractionating column (17), where the materals which are too heavy for the final product are separated as bottoms, the finished product being taken over-head, condensed and run to storage.

The process of regenerating the catalyst tower consists of passing through them products of combustion from a gas fire tower under controlled conditions of temperature, pressure, and water vapor saturation. This requires an air compressor for the necessary supply of air, a small pressure retort in which the combustion takes place, scrubbing equipment for removing carbon dioxide from the products of combustion, and a small auxiliary air heating furnace for controlling the temperature of the air passed to the catalyst towers.

The product from any of these processes must be treated for gum and color stability, and for sulphur if present. Vapor-phase clay treatment has been found satisfactory for gum and color stability; sulphur can usually be controlled by a strong caustic wash, or by several of the well-known standard sulphur treatments.

## Yields

An analysis of yields for the Unitary Thermal Process is given in Carey's article in the December, 1936, issue of the Refiner and Natural Gasoline Manufacturer. He presents two cases showing the results from feeding propane-butane mixtures; the following tabulation, Table 5, is based on his data.

The above figures indicate a net yield of something like 35 to 40% by weight of the feed can be expected from a fairly representative feed stock taken from a natural gasoline stabilizer. They also indicate that some appreciable conversion of propane must occur in this process, since the feed stock containing the

**TABLE 5**

| Charge | | | | Raw* Yield | Finished Yield | | Yield | Yield |
|---|---|---|---|---|---|---|---|---|
| Comp. | Cubic Ft. | Pct. by Weight | Pounds | Gals. | Gals. | Yield Pounds | Pct. Total | Pct. Butane |
| $C_3H_8$ | 31,000 | 56.6 | 3600 | | | | | |
| $C_4H_{10}$ | 18,000 | 43.4 | 2758 | | | | | |
| | | | 6358 | 480 | 408 | 2460 | 38.7 | 89.3 |
| $C_3H_8$ | 143,000 | 61.5 | 16620 | | | | | |
| $C_4H_{10}$ | 68,000 | 38.5 | 10410 | | | | | |
| | | | 27030 | 2030 | 1725 | 10410 | 38.5 | 100.0 |

*Appr. 63.5° A.P.I., 500 E.P. Raw Poly liquid, losing appr. 15% in reducing E.P. to 440° and clay treating.

**TABLE 6**
**PHYSICAL PROPERTIES OF TYPICAL FINISHED POLY PRODUCT**

| A. S. T. M. DIST. | |
|---|---|
| I. B. P. | 99°F. |
| 5% | 118 |
| 10% | 124 |
| 20% | 135 |
| 30% | 146 |
| 40% | 158 |
| 50% | 174 |
| 60% | 192 |
| 70% | 214 |
| 80% | 251 |
| 90% | 316 |
| 95% | 374 |
| E. P. | 405 |
| % Rec. | 98% |
| Res. | 1% |
| Loss | 1% |
| Reid V. P. | 9.2% |

**GENERAL QUALITIES**

1. **High Volatility**—40% over at 158°, against 20-25% for ordinary gasoline.
2. **High Octane Number**—80 to 85 ON straight; blending value up to 110 depending on ratio and blending stock.
3. **Ease of Treating**—Vapor phase clay treats to 30 plus stable color and satisfactory gum (10 mgm/100 cc).
4. **Composition** — Predominantly paraffine hydrocarbons from paraffin feed (propane and butane). Product averages 62° to 65° A. P. I. gravity.

larger percentage of propane shows the larger percentage of yield, referred to the quantity of butane in the feed.

The Shamrock Dubbs plant is being operated on practically pure fractionated butane, substantially free of propane. Under the most favorable operating conditions the yield of finished product is about 0.35 gallon per gallon of raw butane charged, indicating a recovery of about 45% on the weight basis. The conversion of propane is felt to be so low by the advocates of this process as to not warrant the additional plant capacity required to handle it.

### Nature of Product

Table 6 presents in condensed form the principal properties of the product. Its chief value lies in the qualities of high octane value and high volatility. These properties make the poly product particularly interesting for the manufacture of aviation fuels. The blending value for raising the octane number of other types of gasolines depends, of course, on the nature of the base stock and on the blending ratio. In one case blending about 25% by volume of poly liquid with a straight-run gasoline of 40 octane number, the effective blending value runs from 105 to 110 octane number. In general, the higher the octane number of the base stock and the higher the percentage of poly liquid added, the smaller the effective octane number of the poly.

### Plant Investment

It is difficult to give anything but quite general figures on the total investment required for building a polymerization plant, on account of the large number of variables which may affect the cost of any particular project.

**TABLE 7**

| | Daily Propane — Butane Feed | |
|---|---|---|
| | 319,200 gals. | 152,000 gals. |
| | Daily Production | |
| | 2,100 bbls. | 1,000 bbls. (Est.) |
| **DIRECT OPERATING COST per calendar day** | | |
| Operating labor | $ 80. | $ 80. |
| Operating supplies | 5. | 5. |
| Maintenance (@ 4% annum on investment) | 137. | 93. |
| Fuel, @ 80¢ bbl. | 243. | 162. |
| Steam @ 30¢ /1000 lb. | 23. | 16. |
| Power @ ¾¢ /KWH | 412. | 274. |
| Water, @1¢ /1000 gals. | 117. | 78. |
| General expense | 30. | 20. |
| Total Operating Cost / Day | $1047. | $ 728. |
| **Debit:** | | |
| **Net Charge,** on basis 37% net yield by weight, evaluating liquefied propane-butane charge at 1¢ / gal. fuel value and cost of preparating | $3192. | $1520. |
| **Direct Operating Cost,** as above | 1047. | 728. |
| **Fixed Charges, basis**—Interest 5% | | |
| Obsolescence and Depreciation 20% | | |
| Taxes and Insurance 2% | | |
| Total Fixed Charges 27% | | |
| 2100 Bbl. Plant Investment $1,250,000 | 925. | |
| 1000 Bbl. Plant Investment 833,000 | | 616. |
| Total Debits | $5164. | $2864. |
| **Credit:** Gas Oil produced 232 bbls. @ $1.30 | 301. | |
| 110 bbls. @ $1.30 | | 144. |
| Net Total Cost Per Day | $4863. | $2720. |
| Net Cost / gal. of Poly Gasoline | 5.51¢ | 6.48¢ |

Assuming a supply of raw material is available for the feed, the cost of a Dubbs plant to handle 1000 bbls. per day of raw feed will run around $300,000, exclusive of storage, facilities for producing about 800 boiler H. P. of steam and for providing the compressed air required for the regeneration of the catalyst towers. The cost of a Polymerization Process Corp. plant will probably run about the same, although no definite figures are available covering such a plant to treat straight natural gasoline stabilizer discard.

The cost of the installation required to provide the feed stock will, of course, vary widely with plant conditions. It may be necessary to greatly increase the oil-circulating capacity of the gasoline plant in order to get the necessary extraction of butane or butane-propane. This may mean doubling the gasoline plant facilities, or more. In any event, a considerable investment is necessary in equipment to capture and prepare liquid butane from the plant vent vapors. In the case of the Shamrock Dubbs plant built last winter, the cost of the plant modifications required to provide a feed of 1000 bbls. per day of fractionated butane was approximately equal to the cost of the polymerization unit itself.

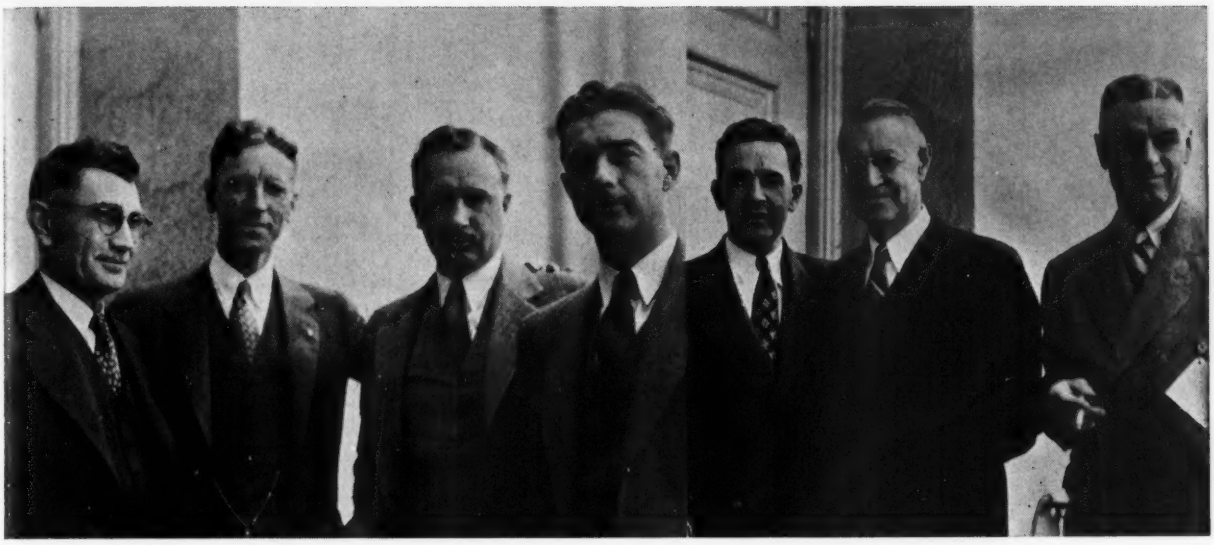
The cost for larger units, will, of course, not go up in direct ratio with the capacity—for example, a plant to handle 2000 bbls. per day of raw feed would probably cost not over 150% of the very rough figures given above.

### Costs of Production

A cost analysis for operation of the Unitary Thermal process is presented in Table 7. The figures for direct operating costs are based on a similar analysis given in Keith and Ward's article in the November 28th, 1935 issue of the Oil and Gas Journal. The figures in that article are for a plant producing 2100 bbls. per day of product, operating on refinery gas containing 22.3% of unsaturates; the same operating cost figures were used in the first column of Fig. 9. The figures for the 1000 bbl. plant are based on the assumption that most items of operating cost, also the plant investment, would be about two-thirds of the figures for the larger plant.

In this analysis of costs there are two items which may be open to question.

The first of these is the value of 1c per gallon placed on the charging stock. It is felt that this is a reasonable and conservative value based on average operating conditions; however, if there is any market for the butane or propane mix-



Reading from left to right these natural gasoline conventioneers gathered for serious thought on association matters, are. John Farmer, Roy Bauer, J. T. Van Rensselaer, Robert Few, Art Delaney, B. G. Williams, and R. D. Gibbs.

ture as such, this value would be in most cases much too low.

The second item which may be open to question is the rather high charge of 20% for obsolescence and depreciation. It is felt that, in the present state of the art, this rate is justified for two reasons. In the first place, a good deal of the equipment is required to operate under rather extreme conditions of pressure and temperature, which lead to rapid deterioration. Secondly, it is felt that future developments are likely to make plants, built according to present ideas, obsolete to a greater or less degree in a comparatively short time.

As shown by the final figures in Table 7, assuming the reasonable accuracy of the detail costs presented the net cost at the plant of the finished poly gasoline is about 5½c per gallon for a plant producing around 2000 bbls. per day, and about 6½c per gallon for a plant producing 1000 bbls. per day. These plants would require a raw feed of about 320,000 gallons per day and 152,000 gallons per day, respectively.

It should be noted that the figures presented are based on the straight thermal process, where mixtures of propane and butane similar to those shown in Table 5, are charged to the unit. If substantially pure fractionated butane is charged, as in the Dubbs process, the amount of butane must be increased correspondingly to produce the same total final yield. I have shown that the yield from typical butane-propane mixtures is about 37% by weight, whereas the yield from straight butane feed through the Dubbs process is about 45% by weight. This would mean that for an equal yield of final product, the total weight of straight butane charged to the Dubbs process would be only about 82% of the total weight of butane-propane mixture required for the thermal process; however, the amount of butane itself required for the Dubbs process feed would be just about double the amount of butane required in the mixed feed to the thermal process, for the same total amount of final product.

## Economics

The question of whether or not a polymerization unit will pay is purely a question of determining whether the value of the material produced at the time and place under consideration exceeds the approximate cost as indicated by the figures presented in Table 7.

Considering the poly product itself for use straight as motor fuel, there are probably very few locations at the present time where a profit could be shown in competition with other methods of producing motor fuel. However, there may obviously be cases where the value of the poly product for blending purposes may be much greater than its value if used straight for motor fuel. This question must, of course, be worked out on the merits of each individual case.

In the case of the Shamrock-Dubbs unit, the owner company had an oil refinery which produced gasoline of exceptionally low octane number, making a base blending stock which could use the peculiar properties of the poly product to greatest advantage. In spite of the fact that the value of the finished motor gasoline at the refinery was in the neighborhood of 4½c, the value assignable to the improvement of octane number of the finiished product obtained through the use of the poly gasoline indicates a very satisfactory profit on the operation of the poly unit.

## References

The following list of references covers some of the later articles which have appeared in publications regarding polymerization. As mentioned in the references, several of them, themselves, carry more or less complete bibliographies, particularly the 2nd reference under the general heading of "Process", which carries 145 references.


**Process—Unitary Thermal Polymerization Process.** J. S. Carey—Refiner & Natural Gasoline Manufacturer—Dec. 1936. (Full discussion of process and chemistry.)

**Motor Fuels of High Octane-Blending Value Produced by Thermal Process**—P. C. Keithe, Jr. and J. T. Ward—Oil & Gas Journal, Nov. 28, 1935. (Discussion of process and economics. Contains a very complete bibliography of 145 references.

**Polymerization a Major Factor in Tomorrow's Super-Fuels.** Gustav Egloff, National Petroleum News, Oct. 14, 1936. (Describes Dubbs Catalytic Process. discusses chemistry—3 References).

**Chemistry.**

**Motor Fuel Isoparaffins by Thermal Gas Polymerization.** F. E. Frey—CNGA—1936 (Discussion of experiments and chemistry.)

**Industrial and Engineering Chemistry,** Frey and Hepp, V-28, p. 1439 (1936).

**Products of Polymerization**—C. M. Ridgway, C. R. Wagner, H. R. Swanson, Natural Petroleum News, Nov. 4, 1936—(Discussion of thermal process modified for special products—5 references.)

**Reaction of Pure Hydrocarbons,** by Gustav Egloff, Reinholdt Publishing Corp., 330 W. 42nd St., New York City. (1937).

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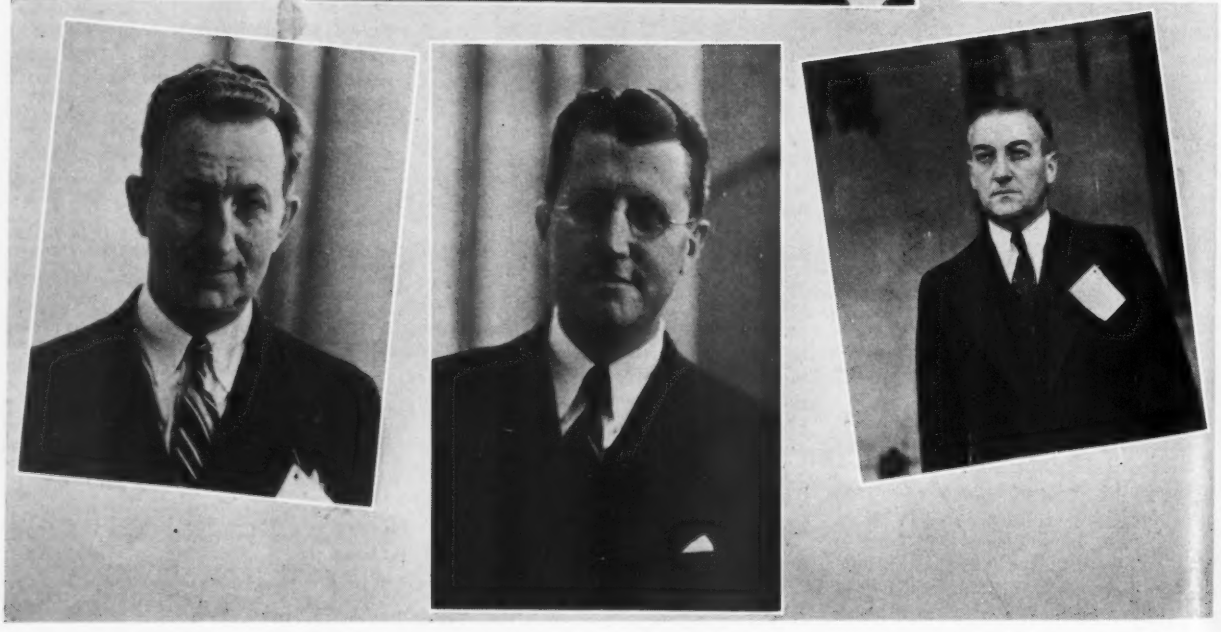
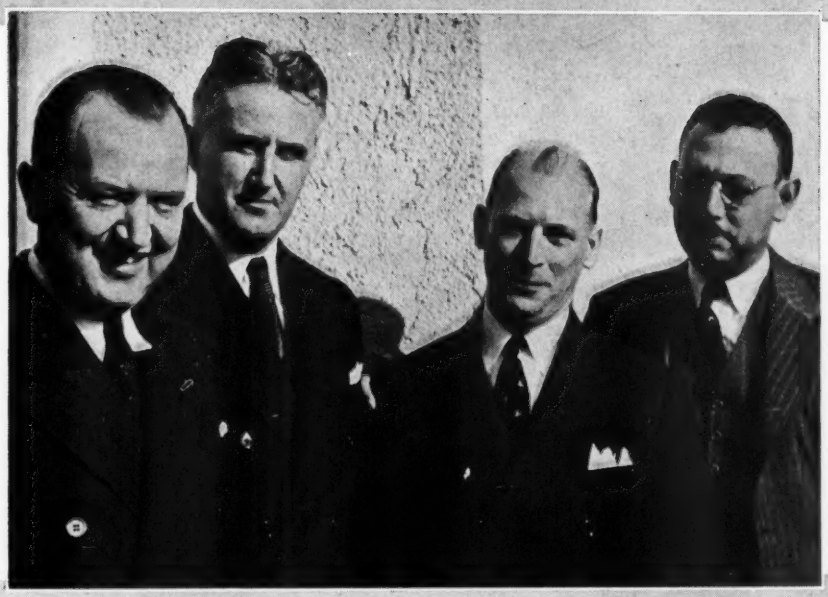


1937 FALL MEETING



# Trend of California's Natural Gas Industry

By LESTER C. UREN
Professor of Petroleum Engineering,
University of California
At C. N. G. A. Fall Meeting

Lester C. Uren

We hear much of things that are "bigger and better" in California, but there are still many citizens of this commonwealth who have not yet come to a proper appreciation of the industry that I have been asked to speak to you about today: our natural gas industry. There is perhaps, good reason for this. It is and industry that produces a commodity that has no place on the shelves or in the show windows of our merchants. This commodity is advertised on no radio programme. It does not appear in our rail or water-borne commerce. We do not import or export any of it. It emerges from the deep-seated recesses of the earth where it has been stored by nature, only long enough to have a little gasoline wrung from it, and then, without ever seeing the light of day, it plunges back underground, eventually to appear furtively in somebody's kitchen or basement or under someone's boiler or furnace or in someone's engine. And curiously, we have come to know this commodity only by the beneficial services that we derive from it and by the bill that we receive each month from the gas company.

These services we owe to an industry that has come to be one of California's most important industries: one that serves directly more than half of the people of this State; one that gives employment to thousands of its citizens. Offering a plentiful and cheap supply of industrial fuel, it attracts important industries that give employment to many other thousands. It is interesting to note that no other California industry yields its product in such great volume: upwards of 350 billion cubic feet being produced in 1936. Perhaps some of us here do not realize that the oil and gas fields of California produce more natural gas than do those of any other state in the United States, with the single exception of Texas: more than is produced in any foreign country. Naturally gas ranks third in value among California's commercially produced mineral products, its value at the wells being estimated at approximately 18½ million dollars in 1936, a sum exceeded only by the value of our petroleum and gold production. If we consider the value at points of consumption, the figure would be approximately 80 million dollars, placing it second in value only to petroleum, in California's list of mineral products, an amount higher than the value of natural gas consumed in any other state or country of the world.

### Two Decades of Development

Many of us here today have, within our own generation, witnessed the growth of this industry from little or nothing to its present commanding position. There has, of course, been minor field and local use of natural gas as a fuel and as a source of light and power since the early days of the petroleum industry, but it was as recently as 1913 that the first pipe line was constructed in California for what might be termed long-distance transmission of natural gas. This was the Midway Gas Co.'s line from the Buena Vista Hills in the southern San Joaquin Valley to Glendale, a 12¾-in. line about 107 miles long. Connected with this was an extensive utility distributing system serving consumers in Los Angeles and other near-by towns and cities. Gradually this system was extended particularly during the post-war years 1923 to 1929, until most of the oil fields capable of yielding commercial production in the southern San Joaquin Valley, the coastal belt as far north as Santa Maria and the Los Angeles basin, were afforded an outlet to the Southern California markets.

Later, with the discovery of large reserves in the Kettleman Hills and other fields in the San Joaquin Valley, subsequent to 1928, came the invasion of the San Francisco Bay region with large capacity transmission lines and distributing systems affording important new outlets

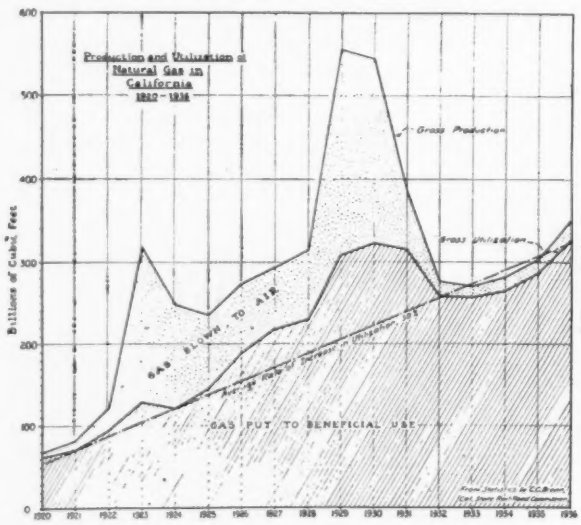

Production and Utilization of Natural Gas in California
1910 - 1936
Billions of Cubic Feet
Gross Production
GAS BLOWN TO AIR
GAS PUT TO BENEFICIAL USE

Fig. 1

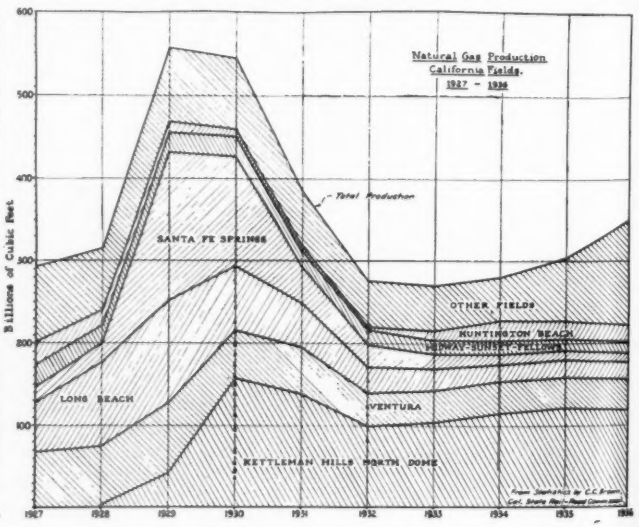



Fig. 2

for natural gas in the Bay cities and other communities of Central California. Additional outlets were also provided to the Southern California markets. Still more recently, through the aid of the science of geophysics, has come the discovery of important new reserves in the southern San Joaquin Valley and in the San Joaquin Delta region; new reserves that promise further expansion.

### Production, Utilization and Wastage

All of this is a story familiar to most of us, and I venture to sketch it here only that we may have in mind how really brief is the period over which our natural gas industry extends, and how rapidly has been its expansion. We can perhaps better appreciate this by reference to some graphs which will indicate the rate of increase in production and utilization of natural gas in California over the past 17 years. (See Fig. 1). The upper graph shows the production year by year, reaching a peak of something in excess of 557 billion cu. ft. in 1929. The lower graph indicates the amount of natural gas utilized year by year since 1920, showing an average rate of increase of about 30% and reaching a maximum value in 1936. The area between the two graphs represents gas produced in excess of market demand, and wasted. It will be observed that wastage has at times, been excessive, particularly in 1923-25 and 1929-30. The first of these two periods was at a time when the upper zones at Santa Fe Springs, Long Beach and Huntington Beach were in flush production: all "town-lot fields" where highly competitive conditions developed. The high production peak and excessive wastage of 1929-1930, followed upon the discovery of temblor production in the North Dome of Kettleman Hills and the lower zones at Long Beach and Santa Fe Springs. It is a reflection on our industrial efficiency that wastage of this valuable and irreplaceable resource has at times been as great as 45% of the gross production, as in 1929. Happily, since that time, wastage has greatly diminished. Recently it has been only 7% of the gross production. This is partly due to the comparative absence of highly competitive situations in recently developed flush fields, in part also, to proration of oil production and operation of the natural gas conservation law, which became effective about 1930.

### Yield of Principal Producing Fields

The graphs of Fig. 2 show the relative production of natural gas, year by year, since 1926, for the state as a whole (uppermost graph) and the yields obtained from the more important producing fields. It will be observed that the Kettleman Hills North Dome field has produced a large part—about 30%—of the state's total supply since its discovery in 1928, and that it is currently producing a slightly larger percentage. The Ventura, Long Beach, Santa Fe Springs, Huntington Beach and Midway-Sunset-Fellows fields have also been important producers but have definitely passed their production peaks as far as zones now exploited are concerned, and are declining in productivity. Table 1 gives statistics of all gas-producing fields of California during the ten-year period 1927-1936 presenting data that have been compiled by C. C. Brown of the California State Railroad Commission. The table names all fields that are contributing important amounts to the current supply. It will be observed that in all but a few instances, annual productions have lately been declining. These exceptions are either new fields or cases where deeper sands or extensions of older fields have lately been discovered. It is interesting to note how, during recent years, the production center has been shifting from the Los Angeles Basin to the San Joaquin Valley.

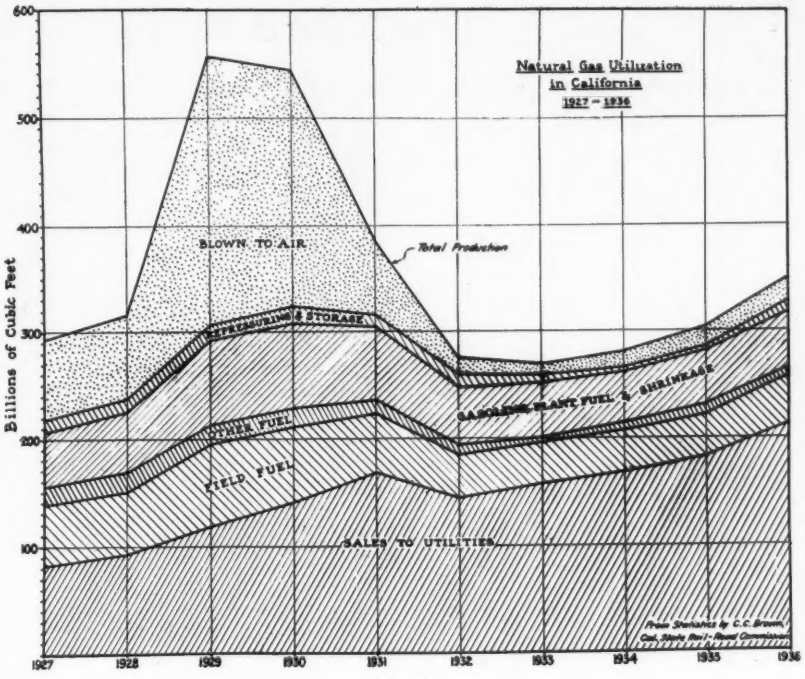


Fig. 3

Of all of the producing fields having developed gas reserves of economic importance, two are outstanding. These are the Kettleman Hills, North Dome and Ventura fields. Probably more than half of the present known natural gas reserves of California are in these two fields, and there are informed people who would say that this is true of the Kettleman Hills field alone.

**Kettleman Hills North Dome,** discovered in 1928, doubtless California's principal known gas reserve, aggregates an acreage not yet accurately determined, but variously estimated at upwards of 17,000 acres. Reserves thus far developed are largely within some 1500 ft. of Temblor (Lower Miocene) sediments, though promising showings have been had from deep tests into the underlying Eocene beds. One of these, only recently tested and still drilling, found substantial oil and gas production, and is situated some distance outside of the present defined limits of the Temblor producing zones, suggesting the probability of an important new gas reserve. Temblor gas reserves in Kettleman North Dome are of two categories: first, a primary gas cap in the crest of the structure, originally occupying perhaps 10,000 acres; and secondly, gas in solution in the underlying oil. At the original reservoir pressure, the oil was capable of retaining upwards of 800 c.f. per barrel, but throughout part of the productive area of the field, it is apparently under-saturated. During recent years, the field has been heavily prorated and output of gas has been regulated to accord with the demands of the utility companies. In 1936, the production of nearly 118 billion cubic feet constituted about 33% of the state's total current supply.

**Ventura Field.** It is generally believed that large supplies of gas are yet to be produced from the Ventura field. Aside from Kettleman North Dome, it is probably California's largest present-known

gas reserve. The productive area is not large (1760 acres), but the producing formations are exceedingly thick. Probably in no other producing field are oil and gas secured from so great a thickness of producing formation. The uppermost sands producing substantial volumes of gas were encountered at about 2560 ft., and recently drilled producing wells penetrating to upwards of 11,000 ft., have still not bottomed the producing formation. Most of the present wells penetrated only a portion of the producing formation, and deeper drilling will probably develop important new reserves. Due to high pressures existing in the deeper horizons, the oil contains large amounts of dissolved gas. The field is being exploited by modern engineering methods, with close cooperation between hte operating companies. Much gas is cased off in the gas-cap area of the field, and high gas-oil ratio wells are restricted or entirely shut in. During the last three years, there has been little change in the rate of gas production, being about 39 to 40 billion cubic feet, or about 11% of the state's total supply.

**The North Belridge Field** has, since its discovery in 1911, been a comparatively small producer of gas, but in 1930, a deep zone was discovered, from which a large volume of high-pressure gas has lately been secured. Under proration the gas production has been increasing moderately since 1930, reaching a peak of 36 billion cubic feet in 1936. The field has thus attained, for the first time, third place in the list of productive gas fields, yielding about 10% of the state's current supply. Though the formation pressures in the North Belridge deep zone are high, the productive area is not large,

and it is thought that the gas reserves available for future exploitation are not to be compared with other fields in the list of more important producers.

**Huntington Beach Field.** Since its discovery in 1920, this field has experienced several stages of development, during which extensions of the original field or deeper sands have come into flush production. occasioning separate production peaks. One of these was in 1923, another in 1927 and a third in 1934. The latter was a result of the development of the off-shore crestal area of the structure by slant drilling, and a substantial volume of gas is being currently produced from this source. The field ranked fourth among California gas-producers during 1936, yielding 20¾ billion cubic feet, or nearly 6% of the state's total. The future gas production of this field is problematical because of the little known structural features of the southwestward or oceanward flank, but it is believed that it may have potentialities for additional substantial production.

**The Long Beach Field,** one of California's most prolific oil and gas producing areas of earlier years, reached its maximum gas production in 1924, only three years after discovery, then declined but attained a second peak almost as great as the first with the development of the Deep Zone in 1929. After 1930, the rate of gas production declined rapidly. For the last three years, the production of the field has been almost constant, the 20 billion cubic feet produced in 1936 being about 6% of the state's total gas supply. Though the producing formations are thick, the producing area is only slightly in excess of 1300 acres, and so intensively has the

Long Beach field been drilled, that it is believed the remaining reserves are unimportant in comparison with those of the fields previously discussed.

**The Dominguez Field,** an important producer of natural gas since its discovery in 1923, is of additional interest for its development along cooperative lines, affording opportunity for reinjection and storage of large quantities of gas, produced in excess of requirements. Early development of the field, by agreement, restricted penetration of the wells to the upper 400 ft. of productive formation, but more recently, deeper strata have been exploited. As a result, the supply of gas has been well maintained, showing a considerable increase during the last five years as a result of deeper drilling. In 1935, the field ranked sixth among the gas-producing areas of the state, with a yield of something in excess of 18 billion cubic feet, or 5% of the total supply.

**The Mountain View Field,** still in flush production, has been steadily increasing its gas yield, since its discovery in 1933. The 1936 production was upwards of 15 billion cubic feet, placing the field seventh in the list of producers. It is believed however, that this field will not greatly increase its gas production above present levels, and that its decline may be rapid.

**The Midway-Sunset-Fellows-Buena Vista Hills Field** is, of course, among the older producing areas of the state and gas production has been continually decreasing during the last 10 years. Nevertheless, it is still a substantial gas producer and the slowly declining production may continue for many years into the future. Some wells drilled within this region have been phenomenal gas producers, particularly those in the Buena Vista Hills and Fellows districts. It will be recalled that the Buena Vista Hills development led to the construction of California's first long-distance gas transmission line: first to Bakersfield in 1911, and in 1913, to Los Angeles. During all of the subsequent years, the area has been a constant producer of gas, aided of late by surplus gas from the Kettleman Hills that has been stored in the Buena Vista Hills structure. In 1936, the Midway-Sunset-Fellows-Buena Vista Hills area ranked eighth among the state's producing fields, with a yield of 14,600,000,000 cu. ft., or about 4% of the total supply. The gas reserves of this area are probably still substantial, particularly if, as some believe, deeper producing zones may be found in the Temblor and Eocene formations.

**The Santa Fe Springs Field,** one of the principal gas-producing fields of the state in 1923, and again with the opening of the deeper zones in 1929 and 1930 is now a comparatively small producer. In 1936, it ranked only ninth in volume of production among the gas-producing fields of California and is showing a definite decline that seems to indicate a much less important role for this field in future years. A multi-zone field, oil and gas have been produced from at least eight formation intervals. It is thought that the gas reserves of this field, available for future exploitation, will be comparatively small unless new and deeper zones than those yet developed, are disclosed.

**Elk Hills.** Though first drilled more than 17 years ago and current gas production is small, it is generally believed that substantial reserves of gas still exist in the Elk Hills field. It is considered probable also, that deeper formations than those yet exploited in the area, may in future be discovered. A small portion of this area, now involved in litigation, has been intensively exploited since 1920, but most of the productive area lies within the naval reserve which, in accordance with government policy, has remained undeveloped. Whatever its potentialities, it seems unlikely that Elk Hills gas reserve will become available for exploitation in the near future, so that for present purposes it may be ignored.

As shown by Table I, other fields than those briefly reviewed above, are comparatively small producers. In the aggregate, the 10 fields mentioned above produce approximately 82% of the state's total supply in 1936. As shown by Table I, other fields are comparatively small producers. Nevertheless some of the recently discovered fields, which have currently small production, have

Table 1

NATURAL GAS PRODUCTION IN CALIFORNIA - 1927-1936 - MILLION CUBIC FEET

| | 1927 | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brea-Olinda | 9,986 | 10,337 | 8,339 | 8,028 | 5,710 | 3,894 | 3,478 | 3,645 | 3,556 | 3,004 | 59,977 |
| Coyote | 2,948 | 3,052 | 2,379 | 2,886 | 2,045 | 2,097 | 2,447 | 3,298 | 2,910 | 1,586 | 25,648 |
| Dominguez | 8,170 | 5,027 | 5,656 | 5,478 | 6,721 | 9,892 | 10,940 | 11,148 | 13,669 | 18,366 | 95,067 |
| Huntington Beach | 27,819 | 18,287 | 13,778 | 9,473 | 5,895 | 4,529 | 12,333 | 26,175 | 22,652 | 20,726 | 161,665 |
| Inglewood | 9,633 | 7,908 | 6,048 | 4,031 | 2,953 | 2,997 | 1,963 | 1,461 | 1,999 | 1,983 | 40,976 |
| Long Beach | 60,470 | 102,046 | 123,900 | 78,867 | 54,269 | 32,490 | 27,314 | 20,730 | 21,598 | 20,708 | 542,392 |
| Montebello | 2,160 | 2,492 | 2,088 | 1,572 | 796 | 367 | 319 | 313 | 801 | 3,733 | 14,641 |
| Playa del Rey | - | - | - | 3,533 | 8,660 | 6,275 | 4,887 | 2,405 | 7,561 | 6,699 | 40,018 |
| Potrero | 970 | 893 | 826 | 364 | 227 | 164 | 31 | - | - | 467 | 3,942 |
| Richfield | 5,651 | 9,064 | 9,025 | 5,355 | 3,277 | 2,702 | 3,060 | 2,553 | 2,259 | 2,024 | 44,970 |
| Rosecrans-Athens | 6,437 | 4,111 | 4,993 | 4,460 | 2,535 | 1,870 | 2,072 | 1,747 | 1,854 | 3,459 | 35,538 |
| Santa Fe Springs | 19,524 | 23,142 | 179,630 | 131,508 | 43,822 | 27,462 | 18,658 | 13,520 | 12,023 | 11,548 | 480,837 |
| Seal Beach | 20,315 | 10,202 | 20,566 | 10,695 | 5,597 | 2,173 | 3,294 | 3,970 | 2,628 | 4,195 | 83,235 |
| Torrance | 5,604 | 4,158 | 3,552 | 3,063 | 1,678 | 1,433 | 1,343 | 1,271 | 1,254 | 1,230 | 24,586 |
| Miscellaneous | 914 | 844 | 796 | 578 | 169 | 177 | 209 | 138 | 123 | 633 | 4,581 |
| Total Los Angeles Basin | 180,601 | 201,563 | 381,576 | 269,891 | 144,354 | 98,522 | 92,348 | 91,970 | 94,987 | 102,361 | 1,658,073 |
| Capitan | - | - | - | - | - | - | - | - | 223 | 432 | 655 |
| Elwood | - | 246 | 8,935 | 14,289 | 10,632 | 4,582 | 2,478 | 1,392 | 1,350 | 4,407 | 48,311 |
| Rincon-Padre Canyon | 613 | 837 | 1,198 | 1,188 | 874 | 557 | 522 | 430 | 564 | 653 | 7,436 |
| Santa Maria | 2,439 | 2,604 | 2,459 | 1,791 | 1,657 | 1,606 | 1,569 | 1,814 | 1,646 | 1,673 | 19,258 |
| San Miguelito | - | - | - | - | - | - | - | - | - | 1,044 | 1,044 |
| South Mountain | 3,367 | 3,011 | 2,901 | 2,675 | 1,909 | 1,884 | 1,570 | 2,122 | 2,388 | 2,372 | 24,199 |
| Ventura | 68,719 | 72,466 | 85,074 | 59,027 | 56,868 | 40,318 | 38,963 | 39,507 | 37,720 | 38,701 | 537,363 |
| Miscellaneous | 621 | 833 | 811 | 778 | 748 | 1,028 | 446 | 357 | 399 | 751 | 6,772 |
| Total Coastal | 75,759 | 79,997 | 101,378 | 79,748 | 72,688 | 49,975 | 45,548 | 45,622 | 44,290 | 50,033 | 645,038 |
| Belridge | 685 | 796 | 873 | 4,790 | 8,094 | 8,544 | 5,806 | 4,892 | 13,340 | 36,119 | 83,939 |
| Buttonwillow | - | 619 | 1,456 | 3,875 | 93 | 80 | 19 | - | 2,036 | 1,086 | 9,264 |
| Coalinga | 148 | 141 | 135 | 118 | 84 | 279 | 266 | 43 | 43 | 791 | 2,048 |
| Elk Hills | 7,660 | 5,978 | 4,121 | 3,969 | 2,896 | 1,986 | 1,390 | 919 | 831 | 752 | 30,500 |
| Kettleman North Dome | - | 3,920 | 42,855 | 137,093 | 137,656 | 98,966 | 104,426 | 115,729 | 121,440 | 117,766 | 899,851 |
| Kettleman Middle Dome | - | - | - | - | - | - | 3,291 | 3,822 | 1,057 | 4,650 | 12,800 |
| Lost Hills | 742 | 636 | 597 | 92 | - | - | - | 326 | 589 | 487 | 3,469 |
| Midway Sunset-Fellows | 27,214 | 22,510 | 24,042 | 24,893 | 19,154 | 18,335 | 16,804 | 16,304 | 14,823 | 14,614 | 198,693 |
| Mountain View | - | - | - | - | - | - | 80 | 1,730 | 11,483 | 15,622 | 28,915 |
| Rio Vista | - | - | - | - | - | - | - | - | - | 101 | 101 |
| Semi Tropic | - | - | - | - | - | - | - | - | - | 20 | 20 |
| Tan Section | - | - | - | - | - | - | - | - | - | 2,969 | 2,969 |
| Tracy | - | - | - | - | - | - | - | - | - | 2,989 | 2,989 |
| Miscellaneous | 627 | 670 | 801 | 168 | 82 | 190 | 102 | - | 48 | 447 | 2,935 |
| Total San Joaquin Valley | 37,076 | 35,270 | 74,880 | 194,998 | 168,059 | 128,380 | 132,164 | 143,763 | 165,690 | 158,413 | 1,278,493 |
| Total All Fields | 293,436 | 316,830 | 557,834 | 544,637 | 385,101 | 276,877 | 270,060 | 281,355 | 304,967 | 350,807 | 3,581,604 |

possibilities of developing into important producers during the next few years.

**Recent discoveries in the Southern San Joaquin Valley** are of outstanding interest at this time in their promise of new substantial gas reserves. The Ten Sections and Greeley Fields have already been proven, and within the last few months other very promising discoveries have been made in the same region: namely, the Union Oil Co.'s and the Ohio Oil Co.'s Rio Bravo wells near Shafter, the Superior Oil Co.'s well near the Greeley field and the General Petroleum Corp.'s well near Arvin. Producing from formations 8000 to upwards of 11,000 ft. deep, the oil and gas in these structures exist under very high pressures and are therefore especially significant from the reserve standpoint. The possibly productive acreage in these newly discovered fields is as yet unknown, but primary gas caps of considerable expanse are known to exist, and the oil to be produced will, of course, yield large amounts of dissolved gas.

**Recent Discoveries in the North San Joaquin and Sacramento Valleys.** Of particular interest to communities in central and northern California are a number of dry gas fields discovered within the last few years in the delta region of the northern San Joaquin Valley, and still further north in the central portion of the Sacramento Valley. The field near Tracy is already developed and connected with distributing facilities. The McDonald Island field will support a number of wells yet to be drilled, but is now producing, and the Rio Vista field in the same region is now being actively developed. It is reported that a well capable of producing 42 million cubic feet was recently completed at Rio Vista. Two wells producing dry gas have now been completed at Marysville Buttes, in the Sacramento Valley, and it is reported that one of these is capable of producing 18 million cu. ft. per day. The Standard Oil Co. has recently drilled a small dry-gas well near Woodland. Most of these fields are situated on comparatively small structures, and though reservoir pressures are high, they probably do not represent reserves comparable with some of the San Joaquin Valley and Los Angeles Basin fields that have been previously discussed. However they are of interest as a type of gas reserve that may be drawn upon as required, without regard to oil proration restrictions, and as a floating reserve they are doubtless of considerable value to gas distributors in central California. Of course, the Buttonwillow, Semitropic, Trico and Buena Vista Lake dry gas fields, further south in the San Joaquin Valley, are of the same character, but they are more remote from the central California markets.

**Recent Discoveries in the Los Angeles Basin and Coastal Belt.** The recent development at Wilmington is, of course, currently yielding a small quota of natural gas, but due to competitive conditions, it is believed that this will be short-lived. The production at El Segundo is also comparatively small. Development of the new producing area near Santa Maria has not yet progressed sufficiently to afford a basis for estimating its future potentialities.

### Estimate of Gas Reserves

The author is not in a position to offer accurate estimates of California's natural gas reserves. Indeed, it is doubtful if really dependable figures on this subject are available to anyone, though doubtless reliable estimates are available on most of the individual fields, in the files of the various producing and utility companies. As far as the writer is informed, only one authoritative, all-inclusive estimate of California's proven gas reserves has been publicly offered. This is to be found in a volume entitled "Geology of Natural Gas," published in 1935 by the American Association of Petroleum Geologists. The figure given is 34 trillion cubic feet. Probably the authors would place little emphasis on the accuracy of this figure: it is simply an estimate by capable geologists having more than the usual amount of information at their command.

The methods used in estimating gas reserves involve the use of factors of sufficient uncertainty to permit of reasonable differences of opinion in interpretation of data and drawing of conclusions. For example, nearly 21 trillion cubic feet of the 34 trillion in the estimate to which reference has been made, is attributed to Kettleman North Dome; and yet, testimony before the California State Railroad Commission by a nationally known authority, a few years ago, estimated the gas reserves of this field at only 3.5 trillion cubic feet. The present author would estimate the Temblor reserves of this field at an intermediate figure, nearer the lower than the higher. Even so, a conservative estimate of present-known gas reserves in all California fields, without placing undue emphasis on newly discovered and as yet undefined fields, would—in the opinion of the author—indicate a probable "visible" reserve for the state as a whole, of upwards of 20 trillion cubic feet.

### The Undiscovered Reserve

Though sixty years of exploration and development has served to disclose the more obvious gas reserves of California, no one who has closely followed the growth of California's natural gas industry during recent years will contend that all of the gas pools of this state have now been discovered. Just where and when new pools will be found and how prolific they will be, no one may know; but there is little doubt but that new and probably important gas reserves will be found in California in future years, not only in new areas not now productive, but also in deeper horizons in the present producing territory. The new science of geophysics has been instrumental in finding some of the recently discovered fields in the southern San Joaquin Valley, and it is reasonable to assume that as we learn better to interpret geophysical records, these methods will lead to the discovery of other structures which, because of absence of surface expression, have hitherto escaped detection. There may be many important gas and oil bearing structures buried beneath the deep sediments of the San Joaquin Valley or the delta region of central California. Also, superior drilling methods and equipment are enabling us to drill deeper than has hitherto been possible, and it is quite probable that deeper drilling will disclose gas reserves in present-known structures, at depths hitherto unattainable. Obviously, we may not place definite value on these undiscovered reserves, but the strong probability that they will from time to time be found and made available, promises continuance of the natural gas industry beyond the time when the present known reserves will be exhausted and lends stability to the gas industry and others dependent upon it.

### Utilization, Prospective Demand

It has been noted, with reference to Fig. 1, that the quantity of natural gas annually finding economic use, increased from about 62 billion cubic feet in 1920 to about 327 billion in 1936. This is an average rate of increase, based on the 1920 consumption, of about 30%; a sustained rate of increase attained by no other mineral industry product. Fig. 3, shows for each of the last 10 years, how this gas has been consumed. Inspection of these graphs will show that during the last five years, there has been but little change in the amount of gas utilized for field and refinery fuel, in the manufacture of natural gasoline and for repressuring and storage. Practically all of the increase in consumption has been occasioned by increasing utility sales. In 1936, about 66% of the gas economically used was sold to gas distributors. The volume so used has increased from 82 billion cu. ft. in 1927 to more than 214 billion cubic feet in 1936; an average rate of increase of about

26% over this period. Consideration will lead to the conclusion that the prosperity of the natural gas industry depends primarily upon the utility demand. The volume of gas used as "field fuel" and "other fuel," is largely responsive to changes in activity in the oil industry. The amount consumed in processing gas in production of natural gasoline is roughly proportional to the volume of gas produced. The amount used for "repressuring and storage" has thus far been comparatively small, but should be roughly proportional to the volume of surplus gas, a part of which will inevitably be blown to the atmosphere because of necessity of production and absence of a market outlet.

We may only estimate future demand for natural gas in California by projecting recent trends, with due consideration to population growth and prospective expansion of the consuming industries. The rate of increase in gas consumption has been materially greater than the rate of population increase. Can we expect this rapidly increasing demand for gas, divergent with the rate of population increase, to continue far into the future?

The answer to this question will depend upon our conception of prospective industrial growth within the region served by the California natural gas industry. Fundamentally, the demand will be influenced by supply and price. On the basis of present known and prospective reserves, as reviewed in preceding sections, we may conclude that there will be an ample supply of gas to meet the prospective demand for many years to come. Contracts now in force between the producers and utility companies, covering a large part of the gas to be marketed during the next 10 years or more, give assurance that the field price of gas will be low: so low, in fact, as to offer unusual inducement to new industries seeking a region in which cheap power and fuel may be had. Most business men and economists agree that California is entering upon an era of great expansion, both in population and industry, and there is ample assurance that this will be reflected in a continued growth in the demand for natural gas.

When we come to appraise the future potential market for natural gas in terms of the requirements of different industries and districts, we find added assurance that increased demand will not be lacking. Only within the last six or seven years has natural gas been available in central California and the cities about San Francisco Bay and the market for gas in this region is not yet fully developed. Potentially, it may be regarded as ready for a substantial expansion during the next upswing of the business cycle. Important chemical industries employing natural gas as a raw material are being developed and projected. A large industry based on various uses of "liquefied gas" is being developed. New Polymerization processes promise a commercial outlet for all surplus gas. An iron and steel industry of considerable magnitude, based on an abundant supply of cheap natural gas, may in future become economically feasible in California.

Natural gas finds one of its principal fields of industrial application as a fuel in central power plants designed for the development of electrical energy. Here it is directly replaceable by hydro-electric power, and it is in this application that we find the only immediate prospect of curtailed demand for natural gas. Considerable gas has been used in recent years, in stand-by steam power plants to supplement hydro-electric power in dry seasons or other emergencies. Boulder Dam power has brought an abundance of electrical energy that some believe will not be entirely absorbed for many years to come. In opposition to this view, others suggest that the additional hydro-electric energy from this and other new sources will be quickly absorbed in the continued development of California industries. We have perhaps reached a stage in the development of our water resources wherein most of the inexpensive dam sites have been utilized, and further large projects will be too expensive to be economically justified. Certainly, competition from cheap natural gas, available at the point of use, without large transmission losses, will be keen and will possibly limit further development of hydro-electric projects in the near future, unless they are incidental to the impounding of water as in the Boulder Dam and Central Valley projects.

A large part of the natural gas marketed by California utility companies is used for domestic heating, and here we find promise of a substantial and continually expanding market. An ever increasing number of modern homes in California cities and towns are equipped with gas furnaces and gas heating appliances. For cooking purposes in our homes it is still a preferred fuel, though it is meeting growing competition with electricity. The high cost of coal in this region leaves the domestic heating field practically open to liquid and gaseous fuels, and the lower equipment cost of the latter leaves the average home owner with little choice. It would appear that the domestic demand will continue to be one of the mainstays of our natural gas industry.

We may obtain a conservative estimate of the demand for natural gas in California during future years by projecting the graph of total demand of the last 10 years (Fig. 1) alone a course parallel to the estimated increase in population of the state. Assuming that the rate of population increase maintained during the last 16 years continues, we might be led to predict that by 1950 California will have a population of upwards of 10 million. If we assume the same rate of increase for gas consumption, the demand for gas should increase from its 1936 level of about 326 billion, to something like 425 billion in 1950. It is believed that thsi is a most conservative figure. If we project the average rate of increase in utilization realized over the 1920-1936 period, and assume that the same rate of increase will persist into the future, the indicated consumption of gas in California in 1950 would be about 560 billion cubic feet. Perhaps a compromise between these two figures would be appropriate. If so, we might reasonably assume that the gas consumption in California by 1950 would reach about 500 billion cubic feet. If we accept this as an average rate of consumption for the existing reserves, and assume that these reserves amount to 20 trillion cu. ft. as previously suggested, the present reserves would be sufficient to meet the prospective demand for the next 40 years. Even though we introduce a safety factor of two to cover possible errors in our reserve or demand estimates, we still have 20 years' supply in present known fields. This the writer believes to be a most conservative estimate.

### Stimulating Oil Recovery

It is probable that during the next 20 years, another application of natural gas will develop, which may be expected to have an important influence upon prices and upon the amount of gas available for utility company purposes. Reference is here made to the prospective use of natural gas for restoring and maintaining pressure in the older California oil fields. Use of gas for this purpose has become an established practice in many of the Appalachian and Mid-Continent oil fields and has proven an effective means of increasing oil recovery. In California, reinjection of gas has been practiced only in a limited way in a few fields; notably in Dominguez and Seal Beach, though in other instances, gas has been transported from flush fields and reinjected in older producing areas, primarily with the purpose of gas storage to avoid waste. If oil prices are materially advanced during the next 20 years, as seems probable, it may well be that gas will come to be worth more

to the oil producer as a means of stimulating oil recovery than the prices offered by the utility companies in existing contracts. We find evidence of this in some parts of the Appalachian region, where gas for repressuring purposes commands a price of from 20 to 40 cents per thousand. In exploration of fields by this means, large quantities of gas are temporarily with-held from the utility market, though eventually much of the reinjected gas will be again produced and sold. It is quite reasonable to suppose, if California's crude prices increase to say, two or three dollars per barrel that repressuring operations on an extensive scale will be undertaken in many of the California oil fields, particularly in the San Joaquin Valley and gas available in this region might come to be of greater value for this purpose than for any other.

### Future Price of Gas

It has been shown that the consumption of natural gas in California may be expected to increase during the next 20 years, to rates materially in excess of those which exist today. Yet we have large reserves of gas available to meet this demand, and from such rough estimates of the visible supply in known fields as are possible with present data, expressed in terms of the prospective demand, it seems unlikely that any serious shortage will develop during this period. Prices should therefore not be expected to reach levels in the near future greatly in excess of those that now prevail. Nevertheless, today's prices are abnormally low and we should confidently expect a moderate price advance, particularly during the latter part of the 20-year period, when visible reserves will probably be smaller and consumption at a more accelerated rate.

Statistics on the selling price of natural gas in different states of the United States are available from publications of the U. S. Geological Survey and U. S. Bureau of Mines. They show more impressively than the figures on volumetric production, how rapidly the natural gas industry has expanded in California during the last decade and a half. In 1920 the gross value of California's natural gas at points of consumption was about 12½ million dollars. In 1934, the latest year for which price statistics are available, it was 73 million dollars. During this period, the average value at points of consumption increased from 19.0 cents to 27.2 cents per M. cu. ft. During the period 1922 to 1934 inclusive the average field price diminished from 9.0 cents and 7.0 cents per M. cu. ft.

Inspection of natural gas prices in other regions shows that there is customarily a well-defined trend toward higher price levels as the consuming capacity of the region develops. This is, no doubt, largely a result of depletion of reserves, but is probably also an expression of a continuing demand for gas that builds up gradually with the industrial development of the region and with increase in population. This has been the experience in West Virginia, Ohio and Pennsylvania, in which states the natural gas industry may now be characterized as mature.

Tom Taggart, Jess Burks, Lester C. Uren, B. D. Balthis.

Contracts now in force guarantee low prices for much of the gas to be produced during the next 10 years. Under the threat of the state's gas conservation law, oil producers have been confronted with the necessity of finding economic use for large quantities of gas in order to secure their right to produce oil, and have been led to make contracts with the utility companies at prices lower than have characterized the gas industry of California in earlier years; prices far below the intrinsic worth of the product. Though prices as high as 15 cents per thousand are provided in some of these contracts under remote contingencies not likely to develop, the terms of most of the contracts provide for prices of the order of 5 to 10 cents per thousand; in some cases as low as 3 cents.

When the present contracts, made under the stress of flush conditions and requirements of the conservation law, have lapsed, we may in all probability expect a higher price schedule that will apply to all production during the succeeding years. Just what the outlook for new reserves will be 10 or 20 years from now, no one of course, may know; but we might reasonably expect that visible reserves will be lower than they are today, that oil and gas producers will be better organized and in a position to barter more successfully with the utility companies, that markets for gas will be better developed and prices therefore higher.

### Conclusions

If conclusions are justified when based slender information as are involved in the present review, it would appear that:

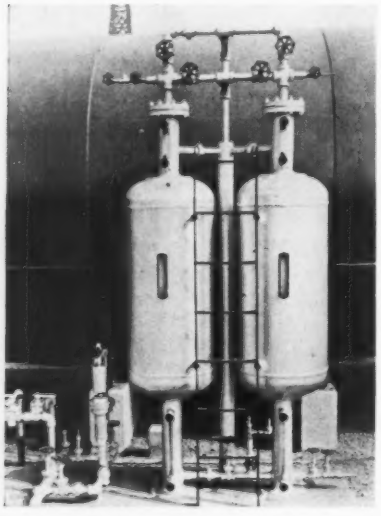
1. California's natural gas reserve available for future exploitation, distributed among approximately 40 producing fields, is probably in excess of 20 trillion cubic feet.
2. Of these fields. the Kettleman Hills North Dome has the largest proven reserve and contains a substantial part of on such uncertain factors and admittedly the "visible" supply for future production.
3. Important new gas reserves have lately been found in the southern San Joaquin Valley and the delta region of the Great Central Valley.
4. Future discoveries of additional gas supplies are probable in this same region, with the aid of geophysics. Deeper drilling in present known fields may also yield additional reserves.
5. During the period 1920 to 1936 inclusive, the average rate of increase in demand for natural gas has been about 30%; largely as a result of increasing utility demand.
6. Wastage of gas has at times been excessive, but during the last five years has not exceeded 7% of the gross production.
7. Growing population, expanding industries, extension of utility facilities, plentiful supply and moderate price promise continued growth in the demand for natural gas, possibly reaching 500 billion cubic feet by 1950.
8. At this rate of consumption, the "visible" gas reserves seem adequate for from 20 to 40 years.
9. Oil producers may in future be expected to reserve a larger percentage of their gas production than at present, for their own use in stimulating oil recovery, possibly with-holding large amounts of gas from the utility market for this purpose.
10. Gradual increase in the price of gas at the wells to moderately higher levels seems probable.

# Proving Procedure for Positive Displacement Meters to Measure Natural Gasoline

By T. R. BEAUCHAMP
At C. N. G. A. Fall Meeting

Some three years ago Mr. C. D. Gard read a paper before this organization the subject of which was "Measurement of Natural Gasoline by Meter". In this paper Mr. Gard brought out many interesting points relative to the disadvantages of storage tanks used for the measurement of liquefied petroleum products which includes natural gasoline. During the last several years a great deal of advancement has been made in the development of accurate and reliable positive liquid displacement meters. This development has induced the trend toward their use for the measurement and sale of natural gasoline. The extended use of metering would greatly reduce the fire hazards in gasoline plants, due to small storage requirements, and would also result in savings of both material and labor by reduction of expensive storage equipment and labor required for gauging. However, the oil industry has been slow to take advantage of this simple method of measurement due to the lack of an adequate, quick and reliable method of testing the accuracy of these meters in service.

It was with these thoughts in mind that the technical committee decided to appoint a sub-committee to investigate and submit recommendations for a proving procedure to make it possible for the industry to adopt metering as a standard method of measurement in the sales and transfers of natural gasoline. It is the purpose of this paper to acquaint you with the progress of your committee.



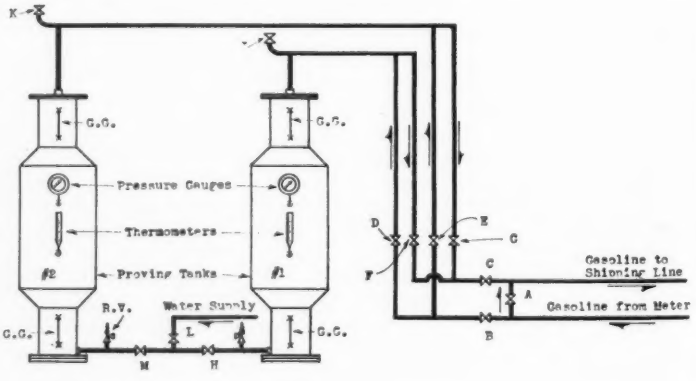
T. R. Beauchamp

During the last several years, both the Union Oil Co. and The Texas Co., being interested in the sale of natural gasoline by metered volume, have spent considerable time and material in the development of satisfactory proving equipment and procedures. Your committee conducted a thorough study of the equipment and procedures as developed by these two companies. One system requires a greater investment for equipment than the other but in turn allows for faster operation. Due to the accuracy obtained through the use of both types of proving equipment, the two systems as developed by their respective companies, together with improvements and refinements made by the committee, will be presented in a bulletin and will be designated as apparatus "A" and apparatus "B".

### Proving Method

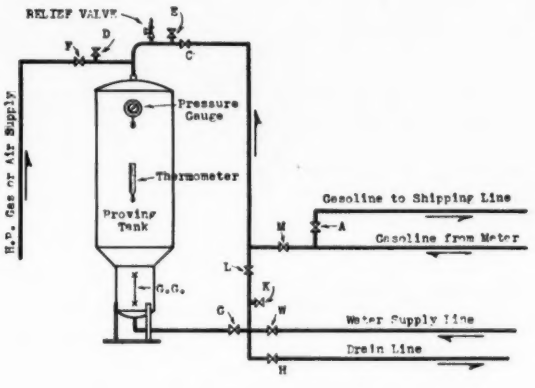
The proving method consists essentally of gauging a metered volume of gasoline in a calibrated container. The gasoline passes through the meter at normal operating conditions and into the proving tank where the volume is accurately determined. The test is conducted under sufficient pressure to avoid vaporization and employs the downward displacement of water. The two types of apparatus both utilize the same principles of operation. The essential difference between the two is that the one designated as type "A" makes use of two tanks, while the other designated as type "B" makes use of one tank.

Tank "A" apparatus (see Fig. 1) consists of two tanks of suitable size equipped with thermometers, gauge glasses, pressure gauges and necessary connections. The two tanks are connected together at the bottom to form a U tube, and so manifolded at the top that gasoline can be pumped into one and forced out of the other and vice versa, to permit the use of both tanks for gauging. This




TYPE "A" APPARATUS

FIG. NO. 1



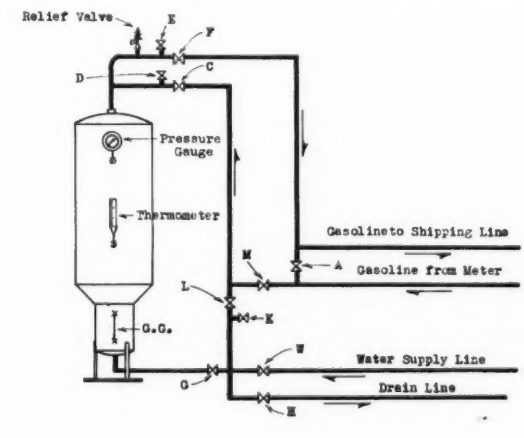

TYPE "B" APPARATUS
Gasoline Displacement By Air Or Gas

FIG. NO. 2

is accomplished by maintaining a volume of water equivalent to the capacity of one tank in one side of the U tube, the other side being filled with gasoline. In proving, gasoline is pumped through the top connection into the tank containing the water, the displaced water going into and forcing the gasoline out of the opposite tank.

Type "B" apparatus (see Figs. 2 and 3) consists of a single tank equipped with a thermometer, gauge glass, pressure gauge and necessary connections. The tank is so connected that it can be completely filled with water. In proving, gasoline is pumped into the tank through a top connection forcing the water out of the tank through a bottom drain. Provision is also made for removal of the gasoline.

Each tank shall be cylindrical in shape with bumped or conical heads to which a neck (type "B") or necks (type "A") of smaller diameter than the tank shall be attached and made an integral part of the tank. It is essential that the construction be such so that the possible trapping of any liquid or vapor in the tank will be eliminated. To insure sufficient rigidity, the tanks shall be constructed with a minimum thickness of ¼" metal and designed according to existing codes, for a minimum working pressure of 75 lbs. per square inch gauge.

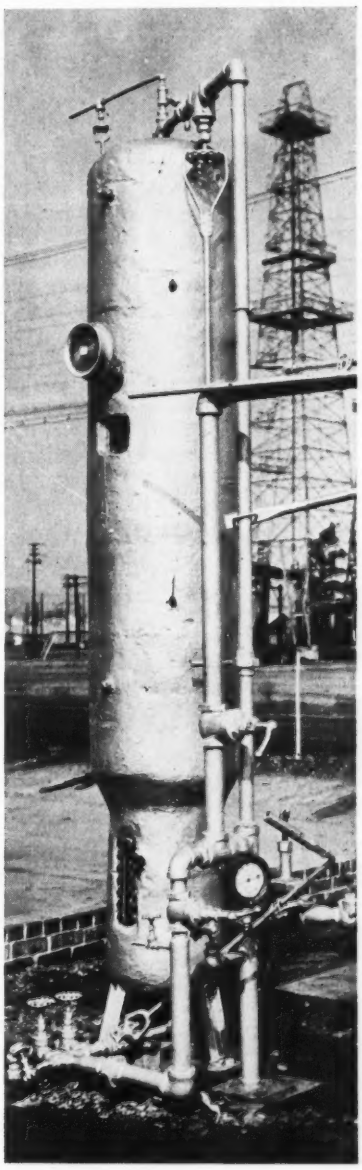



TYPE "B" APPARATUS
Gasoline Displacement By Water

FIG. NO. 3

The size of each proving tank shall be equivalent to at least twice the delivery rate per minute of the meter. The diameter of each neck shall be such that one tenth of an inch vertical height represents not more than .05% of total tank volume. The length of the neck shall be sufficient to accomodate a 12" minimum length gauge glass. Each tank, including the neck, is to be covered with some standard form of insulating material to a thickness of not less than ¾".

A gauge board marked off in divisions of equal gallons and increments of a gallon, the smallest division not to exceed .05% of total tank volume, shall be permanently mounted in such a manner that it is parallel and in close proximity to each gauge glass. For type "A" apparatus, the zero point shall be



taken as the top marking of the upper gauge board. The lower marking of the bottom gauge board shall represent the total calibrated capacity of the tank. The zero point of type "B" apparatus will be explained later. The readings on the board shall be of a permanent nature and may be baked enamel, inscribed in metal, or printed on cloth tape suitably coated to protect it from exposure and mounted on wood or metal stripping.

Each tank shall be equipped with one standard thermometer installed in the center of the tank. Standard thermometers for measuring the temperature of the contents of the tank may be either the industrial or chemical type. The thermometer shall be installed directly through the tank shell with sufficient stem for a minimum immersion of 12", unless such immersion is greater than the radius of the tank, in which case the stem shall extend to the center of the tank.

Calibration of type "A" proving tanks is undertaken after vessels are set up, tested for leaks and secured in a permanent vertical position. Water is measured into the tanks by bucketing with one and five gallon buckets tested and sealed by the Bureau of Weights and Measures, the one gallon bucket being used for the necks and the larger measure for the balance of the tank. It is necessary to note the temperature of each bucket of water and make volumetric adjustment for the thermal expansion of the bucket itself. Upon completion of the filling of the tank the temperature of the water in the tank is observed and permanently recorded as the calibration temperature.

In order to avoid boring you more than necessary with a long, drawn out, alphabetical description of how to prove a meter, I will attempt to describe the highlights of it as follows: Assuming the proving tanks to be empty, with vent and equalizing valves open, introduce enough water into the system to bring the level to the upper portion of lower gauge glasses. Now close equalizing valve "M" and continue filling tank No. 1 until water level reaches mid section of the upper gauge glass. Fill the balance of tank No. 1, tank No. 2 and adjacent piping with gasoline displacing the air and vapor through vent valves. With equalizing valves and lines from meter open to tank No. 1 and all other valves closed, record the pressure on system high gauge and meter reading. Next, open outlet lines from tank No. 2 and main line valve "C", allowing gasoline to enter tank No. 1 at normal operating rate and pressure. Close main line outlet valve "C" when gasoline has appeared in the lower gauge glass. Record meter reading, low gauge and temperature of the gasoline in tank No. 1.

The calibration of type "B" apparatus is essentially the same as for type "A", except that the upper piping is included as part of the tank and for convenience, the water is bucketed out. The upper piping as well as the tank must be completely full of water. This is accomplished by introducing water at the base of tank and venting at top. In proving type "B" apparatus, gasoline is introduced at the top and the water drained from the base through a rate valve, maintaining normal operating pressure. The same information is recorded as for apparatus "A" except that no starting gauge is necessary as the zero point on this type is always the same (i.e. tank and upper piping completely full of water). The same correction factors are applied as for type "A" to determine the net volume and percent of error. At the conclusion of the test the gasoline is removed from the proving tank by displacement with water, air or gas, and the apparatus is then ready for the next test. Tests shall be repeated until two or more consecutive tests check within the tolerance agreed upon.

The temperature correction for reducing the volume of the gasoline to 60° F., shall be made by the use of factors given in the A. S. T. M. Standard D-206-36. For petroleum liquids with an A.P.I. gravity of 100° or higher, correction factors shall be obtained from the Bureau of Standards Bulletin No. 97. This correction is to be applied to both the volume of gasoline gauged in the proving tank and the corresponding metered volume, unless the meter used is one of the temperature compensating type, in which case no correction factor shall be applied to the metered volume.

The calibrated capacity of proving tank is the capacity as determined with the tank shell standing at the same temperature as the water used in the calibration test. This temperature has been designated as the calibration temperature and shall be used as a base for corrections to tank capacity due to the thermal expansion of the shell. If the temperature of the gasoline during the proving test is different from the calibration temperature, the actual capacity of the tank will be different from the calibrated capacity and the proper corrections must therefore be made. The coefficient of linear expansion of the average mild steel plate is approximately .0000063 per degree F. The coefficient of volumetric expansion would be approximately three times this or .0000189 per degree F. With the calibrated capacity of the proving tank known and the volumetric coefficient of expansion shown above, a table shall be made showing the correction in gallons to be added or subtracted to the calibrated capacity for each degree F., that the gasoline temperature is correspondingly higher or lower than the calibration temperature.

The gauged volume of the gasoline in the proving tanks, for both procedures "A" and "B", is obtained under the normal operating pressure of the meter. At this pressure the capacity of the tank is greater, due to the expansion of the metal, than its actual calibrated capacity determined at atmospheric pressure. Also, the volume occupied by the gasoline becomes less, due to its compressibility, as the operating pressure increases. The volume of the gasoline as gauged must therefore be increased by factors representing these two items in order to determine the net gallonage gauged. Since the two factors are both dependent on and proportional to, pressure, they may be combined as a single correction factor, the experimental determination of which will be described in the bulletin.

The frequency of proving tests, the permissable meter error, and the application of results shall not be construed as a part of the bulletin, but shall be agreed upon by the parties interested in the measurement.

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## MIST-D-FIER GAS SCRUBBERS

# Physical Constants

By D. A. SMITH
At C. N. G. A. Fall Meeting

Mr. Chairman, Members of the California Natural Gasoline Association and friends, I should like to express my appreciation for the cooperation and suggestions of members of this committee and of other members of the Association for their help in completing the many details of this problem. Through the bibliography, we give credit to the many workers whose investigations have made possible this compilation of physical data.

This subject of Physical Constants data appears to be a rather dry subject to most of you. I will agree that it is, but after assembling reference material, many interesting details appear. The inconsistencies found make the committee meetings more lively and help the discussion. In contrast to the inconsistencies, one may find a series of measurements which are consistent, and perhaps may be plotted into a straight line by means of some mathematical sleight of hand. It is very rare to find any data which will follow some familiar law, since most of the familiar physical laws have had so many amendments they are hardly recognizable.

The heats of combustion of the paraffin hydrocarbons are an example of consistent data, all being determined recently by one investigator of the Bureau of Standards. Densities, however, are found compared to water at various temperatures and many times without the basis of comparison stated.

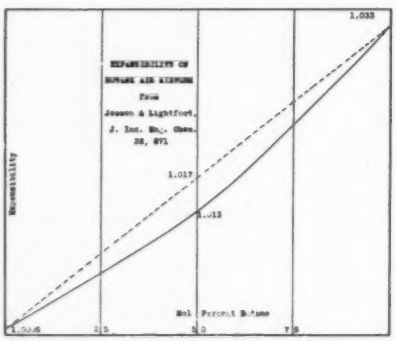


Fig. 2

Other data may be found in various units, which must be recalculated to a common basis. For example, the expansibility values we have found are expressed as volume measurements, as weight in grams of a liter of gas, as compressibility PV factors or as fugacity.

The apparent liquid density of methane and ethane gas dissolved in hydrocarbons is still rather uncertain and not known with a sufficient degree of certainty.

There have been several investigations which give the densities of mixtures of methane or ethane with other hydrocarbons in the liquid state. From this data, the apparent density of the methane or ethane appears to depend upon the percent of the lighter hydrocarbon in the mixture; upon the composition of the liquid it is mixed with; and upon the total pressure under which the liquid exists. We have not been able to correlate this relationship to anything practical, so have offered the values as shown in the table as being the best average for use with natural gasoline plant data.

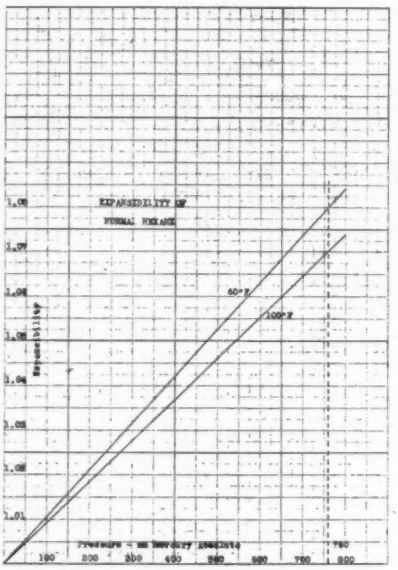


Fig. 1

The indiscriminate application of this one value to production data is not advisable. Crude oils, particularly flow line samples may have relatively large amounts of methane, and the characteristics of these oils have many variations. Also, the pressures under which many of these mixtures exist is considerably above the critical pressure.

For routine testing and for intercompany transactions a uniform method of applying data is desirable and often necessary.

Two methods of applying expansibility data have been suggested. Mr. Laird, in a paper read before the Association, gave maximum pressures at which the various hydrocarbons should be measured to keep the expansibility correction fairly constant. Expansibility is the basis of these pressures.

Expansibility factors also may be applied to each measurement, correcting all volumes as measured to perfect gas volumes. To do this the factors must be known at various temperatures and pressures.

The data at atmospheric pressure and room temperatures for the normal paraffin hydrocarbons up to heptane, but excepting hexane, are satisfactory for our use. Extrapolation of the data is necessary to include the other hydrocarbons and to obtain values below atmospheric pressure.

Fig. 1 shows the expansibility factor for N-hexane at constant temperatures for varying pressures. If we have a volume of N-hexane measured at 60° F and 600 mm absolute pressure the expansibility factor will be 1.065; or if the measurement was at 100° F the factor would be 1.055. Interpolation for other temperatures may be made between these values. For most work interpolation by inspection will be satisfactory.

Having obtained the analysis of a gas in mol percent of perfect gas volumes, the perfect gas relationships of vapor densities or of heat of combustion may be calculated. After making these calculations, correction may be made for the average expansibility of the gas mixture.

Table 1 shows an example of such a calculation for a mixture of propane and iso-butane. Here are the mol fraction and expansibility of the components, and the expansibility of the mixture is 1.019. The perfect gas vapor density of this mixture is 1.618, which, corrected for the expansibility of the mixture and for that of air becomes 1.648. A similar method of calculation would be used to correct the cubic foot vapor per gallon liquid if the results were to be applied to metered volumes.

The heat of combustion of this mixtures per cubic foot of perfect gas volume is 2,672. Correcting this heat of combustion for the expansibility we obtain 2,622 Btu/c.f. of gas as measured at 60° F and atmospheric pressure. Another correction which may be made is that for water vapor. Liquefied gases are practically free of water, hence no correction should be necessary. Natural gas contains varying amounts of water vapor, depending upon its source and method of handling. The standard cubic foot for heat value purposes as defined by the American Gas Association is saturated with water at 60° F. To make such a correction, the heating value of the dry gas is multiplied by 1—(fraction water

vapor.) For this gas, saturated at 60° F. we obtain a value of 2575 Btu/c.f.

Having shown these calculations, I will have to confess they are probably not exact in theory. We have in our data an investigation of the expansibility of butane-air mixtures which show a difference between calculated and experimental expansibilities. For a 50 mol percent mixture as shown in Fig. 2, the expansibility is 1.013 while the arithmetic average is 1.017. When more data is available, the physical constants committee of the future may generalize this relationship so we may take these corrections with greater precision. For the present, I believe the accuracy obtained using the additive relationship is satisfactory.

Some explanation of our heat of combustion values as shown in the table of physical constants may be desirable. The value expressed as Btu/lb. assumes that the heat of vaporization of the liquid is supplied by some outside source. This seems to be the commercial practice and would be the procedure used in determining the heat of combustion by either the Junkers type calorimeter or the combustion pipette. Thus, these values as Btu/lb. and Btu/c.f. are directly comparable.

A few words as to the future program for the committee on physical constants may be of interest. Suggestions have been made while the work was in progress for extending the scope of the data. It was decided, however, that we should not delay completion of this phase to include more data with it.

The first suggestion, I believe, was that physical constants of unsaturated compounds be agreed upon. With the possibility that many natural gasoline manufacturers may be polymerizing gases in the near future, such a table would be very timely.

Another suggestion is that thermodynamic data on these lower paraffin hydrocarbons be published by the association. To have such data accumulated in one source and presented in consistent style and units would be of great advantage.

Vapor pressure charts also are needed which are mutually agreeable to the members of the association.

Some of these suggestions could be carried out without incurring a great amount of time of the committee. To prepare the other data, however, would entail a large amount of detailed work and will be entered upon only if the demand is sufficient. There are probably other suggestions that may be made which, if carried out will make the data of the California Natural Gasoline Association Bulletin a complete working tool for its members.

**Expansibility of a Mixture**

| | Mol Fraction | | Expansibility 760-60 |
|---|---|---|---|
| Propane | .8000 | 1.016 | .8128 |
| Iso-butane | .2000 | 1.03 | .206 |
| | | | 1.0188—1.019 |

**Vapor Density**

| | Mol Fraction | Perfect Gas Vapor Density | |
|---|---|---|---|
| Propane | .8000 | 1.521 | 1.2168 |
| Iso-butane | .2000 | 2.005 | .4010 |
| Vapor Density, Perfect Gas | | | 1.6178—1.618 |

$$\frac{1.618 \times 1.019}{1.0006} = \frac{1.648}{\quad}$$

1.0006 = expansibility of air.

**Heat of Combustion**

| | Mol Fraction | Heat of Combustion | |
|---|---|---|---|
| Propane | .8000 | 2424 | 20195 |
| Iso-butane | 2.000 | 3265 | 6530 |
| Btu/c.f. perfect gas. | | | 26722—2,672 |

2,672 = 2,622 Btu/c.f. dry gas 760-60

1.019

2,622 × .9825 = 2,576 Btu/c.f. gas saturated at 60°F.

## REPORTS ON PROBLEMS No. 4 and 9

Two important committee reports which were presented at the fall meeting will be published in full in the Dec. 5 issue. In one of these papers Warren H. Kraft discusses tank truck gauging, and in the other, Charles E. McCartney covers late information on liquefied petroleum gases.

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# Attendance At Meeting Shows Growth Of Industry

The increased growth of the natural gas and gasoline industry during the past few years was amply demonstrated by the large attendance at the California Natural Gasoline Association's annual fall meeting at the Ambassador Hotel on Tuesday, Nov. 16. Every technical address at both morning and afternoon sessions was well attended.

The technical committee, with C. D. Gard as chairman, arranged a fine program of local speakers for the morning session, and the character of the presentations is evidenced in the fact that attendance at the technical sessions was the largest on record. The speakers, T. R. Beauchamp, Warren H. Kraft, D. A. Smith and C. E. McCartney, had all prepared topics of especial significance to operators, and to the industry generally.

The afternoon session also attracted a record-breaking audience. Here Dr. Lester C. Uren, professor of engineering at the University of California, delivered a highly informative address on present trends and future prospects in the natural gasoline industry on the Pacific Coast. Dr. Uren's paper carried a number of prognostications, based on existing practice and available production, that were of real significance to the industry, and intensely interesting to his hearers. H. N. Wade of Parkhill-Wade, Inc., gave an illuminating talk on the subject of polymerization—a process of comparatively modern development with which every person engaged in natural gas and gasoline operations must sooner or later become familiar.

After the technical and business sessions, the group, about 700 strong, sat down to the annual banquet, presided over by Jess C. Burks, after which they settled back to see what J. W. Reed of the Cooper-Bessemer Corp., had to offer in the way of entertainment. It turned out to be really worthwhile. He did a fine job arranging a vaudeville program that was a honey. From acrobats and rope manipulators to the latest thing in feminine pulchritude the bill was complete. The rope thrower had some difficulty getting his rope away from the audience, and there were one or two impromptu numbers by Tom Taggart, Ernie Adams, Judge Russell, et al., that were not listed, but added to the fun just the same. The whole day's proceedings from beginning to end were thoroughly informative, entertaining and enjoyable. The California Natural Gasoline Association's annual fall meeting is without question rapidly becoming one of the outstanding events of the petroleum industry's year.


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# California Gasoline Sales Decline In September

**Increasing trend as compared with last year continues. Total sales 150,780,327 gallons.**

Taxable gasoline sales in California continue their gain over figures for corresponding months of 1936, even though September, 1937, sales showed a slight decline from those of August.

In gallons, September sales were 150,780,327, a decrease of 4,166,340 from the preceding month's figure, but an increase of 9,756,395 gallons over the sales of 141,023,932 gallons for September, 1936. Total sales for the first nine months of the year were 1,299,675,962 gallons, an increase of 230,146,042 gallons over sales of 1,069,529,920 gallons for the like period of 1936.

Taxes assessed against September gallonage were $4,523,409.84, bringing the 1937 total to the end of September to $38,737,855.68, a monthly average of $4,304,206.19.

Reducing these figures to barrels, September sales were 3,590,008, which brought the total for the first nine months of the year to 30,944,663 bbls., a daily average of 113,350 bbls. During 1936, September sales were 3,357,712 bbls., the total for the first nine months being 28,825,092 bbls. and the daily average being 105,201 bbls. September, 1937, averaged sales of 119,667 bbls. per day, against 119,006 bbls. per day during August and 111,924 bbls. during September, 1936. The discrepancy between the totals for August and September and the daily average for the two months is accounted for by the extra day in August as compared with September.

More than usual realignment among the first 10 companies took place in September. Standard and Shell, the customary two leaders, maintained their positions, but Union, usually third, dropped to fifth, being overtaken by both Richfield and Associated.

In order of taxable sales, the 10 leading marketing companies during September were: Standard, Shell, Richfield, Associated, Union, General Petroleum, The Texas, Wilshire, Mohawk, and Hancock. During August, the line-up was: Standard, Shell, Union, Associated, General Petroleum, Richfield, The Texas, Wilshire, Mohawk, and Hancock.

During September, 38 companies sold 300,000 or more gallons of taxable gasoline. These companies, in order of taxable sales, follow:

| | Taxable Gallonage | Total Sales |
|---|---|---|
| Standard Oil Co. | 24,789,021 | 66,136,319 |
| Shell Oil Co. | 17,348,145 | 30,464,263 |
| Richfield Oil Corp. | 16,566,670 | 22,007,737 |
| Tidewater Associated Oil Co. | 15,355,955 | 22,534,613 |
| Union Oil Co. | 14,434,084 | 19,692,246 |
| General Petroleum Corp. | 11,041,788 | 36,977,634 |
| The Texas Co. | 8,052,911 | 13,786,813 |
| Wilshire Oil Co., Inc. | 6,739,909 | 6,776,238 |
| Mohawk Petroleum Co. | 3,741,541 | 3,921,830 |
| Hancock Oil Co. | 2,823,856 | 3,056,159 |
| Macmillan Petroleum Corp. | 2,478,930 | 2,669,342 |
| Pacific States Oil Terminals | 2,367,849 | 2,367,849 |
| Caminol Co., Ltd. | 2,302,503 | 2,312,782 |
| Estado Petroleum Corp. | 1,797,529 | 1,797,529 |
| Olympic Refining Co. | 1,741,056 | 1,742,748 |
| Norwalk Co. | 1,571,801 | 2,204,428 |
| Seaside Oil Co. | 1,456,656 | 3,488,721 |
| Exeter Refining Co. | 1,294,520 | 1,294,565 |
| R. R. Bush Oil Co. | 1,137,412 | 1,137,532 |
| St. Helens Petroleum Co. | 980,632 | 989,042 |
| Edington Oil & Refining Co. | 919,901 | 919,901 |
| Kreiger Oil Co. | 884,595 | 893,787 |
| Envoy Petroleum Co. | 878,700 | 878,700 |
| M. M. McCallen | 807,202 | 959,453 |
| Social Oil & Refining Co. | 798,870 | 798,870 |
| Operators Oil & Refining Co. | 783,022 | 783,022 |
| Rothschild Oil Co. | 776,443 | 808,127 |
| Triangle Oil & Refining Co. | 682,826 | 682,826 |
| Los Nietos Producing & Refining Co. | 674,121 | 3,121,523 |
| Bachmann Petroleum Corp. | 642,144 | 643,393 |
| El Tejon Refining Co. | 624,167 | 650,556 |
| Aromalene, Inc. | 537,990 | 538,645 |
| El Camino Refining Co. | 435,886 | 435,840 |
| Elm Oil Co. | 427,413 | 427,413 |
| Harbor Refining Co. | 389,332 | 465,035 |
| J. O. Moffett | 383,581 | 383,606 |
| East West Refining Co. | 351,805 | 351,805 |
| Eagle Oil & Refining Co., Inc. | 318,029 | 324,043 |
| All others | 1,441,532 | ..... |
| **Total September** | **150,780,327** | **259,424,935** |
| Total August | 154,946,667 | |
| Decrease | 4,166,340 | |
| **Total to September 30** | **1,299,675,962** | |

A Mountain in the Desert

A pile of sand like this is a common sight beside West Texas oil wells, where THE CAVINS is in demand for use in cleaning-out after shooting with "nitro". It's oil—all that the well can make—that any operator is after and he can't get his maximum if ordinary clean-out tools have left the producing horizons plastered with contaminating material. With THE CAVINS, he can't miss. The powerful fluid surge, which takes place when THE CAVINS takes its load, washes all recoverable material down to the bottom of the hole for easy recovery, leaving the producing horizon open and free to make its normal production.

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# LAUGH THIS OFF

Memory is the feeling that steals over you when an equipment salesman tells you a new story he has just brought back from the A. P. I. convention.

---

And **Phil McGruder** tells the story of two C. N. G. A. lads who recently made a trip to Taft. They stayed overnight at a local hotel, and occupied adjoining rooms with a connecting bath. One of the boys was awakened early in the morning by sounds of great industry in the bathroom. Investigating, he found his buddy brushing his teeth with the usual accompaniment of splutters and snorts. "Hey!" he protested, "That's my toothbrush you're using." The other fellow stopped, looked kinda foolish, and replied, "Gee, I'm sorry. I thought it was just an old one somebody had left here."

---

It is believed that cracking was discovered by a stillman who banked his fires and went to sleep on the job. When he awoke he found the gravity of the stream considerably higher. **Jess Burks** says if a stillman fell asleep on the job today he would discover something altogether different, and the gravity of the stream wouldn't interest him so much as the gravity of his situation.

---

Jess is also of the opinion that Swedish crudes should yield a high percentage of olefines.

---

And **Russ Havenstrite**, who is just convalescing after a bad session of the flu, says polo is a pretty expensive game. It takes a lot of money to buy a string of polo shirts.

By the way, some of the stories are a trifle long this week, but don't be discouraged. **Bill Robinson** (not the tap dancer) points out that many a man has devoted twenty years of his life to the finishing of one sentence.

---

"Would you help a fellow out of trouble?" begged the panhandler, and the oil man replied, "Yeah, would you rather be hit with an axe or shot?"

---

And **Gene Arnold** tells us about a girl up in Bakersfield who is engaged to a pumper. In the meantime, she is preparing for married life by learning to play solitaire.

---

**Bill Pemberton** is of the opinion that the use of local anesthetics in dentistry has done more for the conservation of gas than anything else outside of the industry.

---

**Howard Robinson**, on the other hand, declares that a good pipe liner must not only know his onions, but must also be able to indentify leaks.

---

And, although we heartily dislike anything that is common, we could really enjoy a common stockholder.

---

**Bob Roberts** now interrupts to remark that any salesman who is familiar with the game of golf must realize the necessity of a good approach.

So also must any individual who has survived an argument with a freight train.

---

Reverting again to golf, **Frick Gibbs**, who is no mean exponent, says that the national game is just pie to some people, which perhaps explains why we get so many slices.

---

**Doc Emmons** next points out that scientists all over the world are trying desparately to find some means of dividing the atom, which is nothing but foolishness. The thing is so small to begin with, and there are so many scientists, **Doc** says, that even if they did succeed in dividing it, the shares would be inconsequential.

---

And **George Prussing** believes that there is something still smaller than the atom that should be dissected—the hit and run driver.

---

Petroleum has been variously and poetically described as "liquid gold," "black gold," etc., but when smeared on white flannel pants it is simply called crude oil.

---

If the victim has sufficient control over his language.

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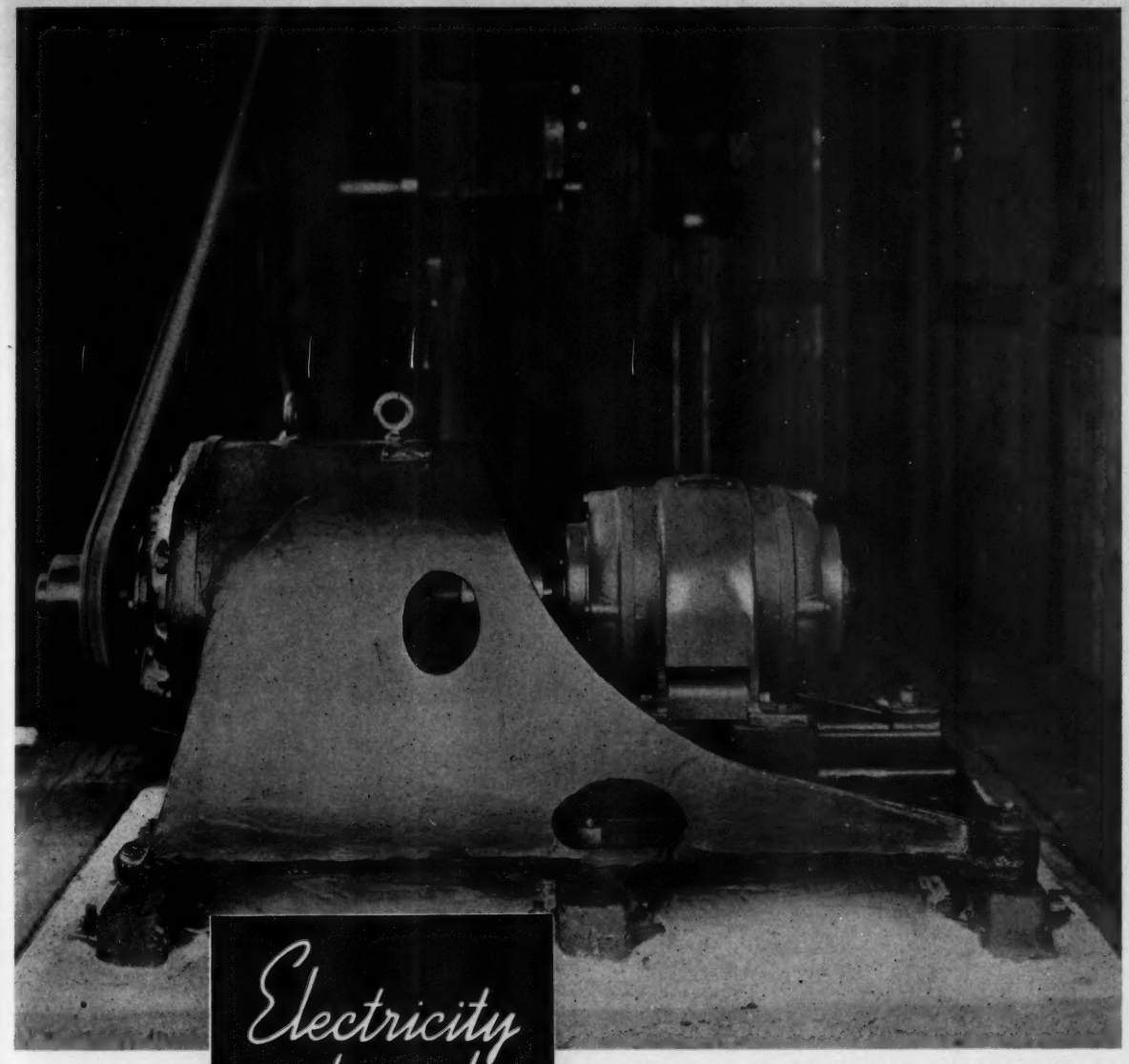
Saying which we take a fond adieu. After all, one reason oysters are so popular is that they know when to shut up.—R. S.



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# Field Development

## San Joaquin Valley

### Kernco Completion Year's Best Discovery

In completing Kernco No. 1 from a depth of 11,302 ft., the Union Oil Co. became the first to obtain a high pressure flowing well from below 11,000 ft. and made what is with out doubt the most important discovery for the year in California.

After cleaning out from the shoe of the blank liner cemented at 11,220 ft. to bottom and 2½-in. tubing run to 10,000 ft., the well started flowing of its own accord at an estimated 2400-bbl. rate but was immediately pinched back with an 8/64-in. bean through which production was reduced to 1400 bbls. After two weeks, the well is flowing 1519 bbls. per day of 39.2 gravity oil with a water cut of 1.5%. A 28/64-in flow orifice is used which maintains 2050 pounds tubing pressure and 1900 pounds casing pressure. Gas production is 2,000,000 cu. ft.

In accordance with a tentative one-well-to-twenty-acre spacing program, Kernco No. 2 has been located 660 ft. north and 660 ft. west from the discovery well which is 330 ft. south and 330 ft. west of the east quarter corner of sec. 34, 28-25. Superior Oil Co., following the same program, has located Wagner No. 1 990 ft. south and 330 ft. east of the west quarter corner of sec. 35, 28-25.

### Three Wells Start In Grapevine Area

Three exploratory projects are now underway in the Grapevine area.

In sec. 33, 11-19 the Universal Consolidated Oil Co. together with the Wilshire Oil Co. and Barnhardt-Morrow is drilling below 2450 ft. on a sublease from the Reserve Oil and Gas Co. This well is an attempt to develop oil production in the area proven to be gas bearing by Reserve No. 33-3 which is now delivering 5,000,000 cu. ft. per day to the new absorption plant.

The Honolulu Oil Co. jointly with the Tidewater Associated Oil Co. is drilling Southern Pacific Land No. 1 in sec. 33, 12-19, just having passed the 1000-ft. level, and the Ohio Oil Co. No. D-2, sec. 23, 11-19 is drilling in hard conglomerate below 1750 ft.

---

### Planning Deep Test South of Devil's Den

South of Devil's Den and west of Lost Hills the Amerada Pet. Corp. is coring brown shale with few oil showings in Beer No. 5, located in section 22, 26-19. Total depth is now below 4350 ft. and the top of the Miocene was cored at 2150 ft.

The Crusaders Oil Co., owner of a number of small producers in Devil's Den, is considering drilling a deep test adjoining the shallow oil production in the proven area.

### Semitropic Wildcat Gets Gas Showing

The Standard Oil Co. and Fullerton Oil Co. joint deep test of the Semitropic gas field, Randolph Comm. No. 1, created a stir recently when it was reported siltstone giving good cuts had been cored from 7422-7494 ft. and good gas shows had been in evidence on the ditch. A formation test, however, revealed only a weak gas blow and only 350 ft. of gas-cut, oily mud was recovered in the drill pipe. Although commercial production was in no sense indicated, the showing is nevertheless regarded to be sufficiently encouraging to warrant deepening in search of more productive lower horizons.

---

### Trico Deep Test Coring in Sandstone

The Standard Oil Co. Morris No. 1, deep test in sec. 36,24-23, continues to explore for oil production without success, being, when last reported, in gray sandstone at 10,205 ft.

In sec. 28, 24-23 Trico Oil & Gas Co. completed Bryson No. 1 as a small gas producer from 2467 ft., production being estimated at 500,000 cu. ft. daily. Valley No. 2, a wildcat of the same company in sec. 35, 21-25 near Tipton, was abandoned at 3705 ft. after coring unsaturated oil sand from 3620-3670 ft.

## Fruitvale Southeast Outpost Produces

The Western Gulf Co., discoverer of Fruitvale, continues to be the field's most successful operator with the completion of Red Ribbon No. 10, a southeasterly outpost well in sec. 27, 29-27. With hole bottomed at 3543 ft. and 8⅝-in. water string cemented at 3354 ft., a perforated liner was landed on bottom and the well swabbed in flowing 1200 bbls. daily through a ½-in. bean. Production has been cut to 585 bbls. of 17 gravity clean oil by reducing the bean to 26/64 which maintains a flow pressure of 310 pounds and a casing head pressure of 920 pounds.

### Sand Trouble Continues

At the north side of the field, the company is still having sand trouble in K.C.L.-B-28 in sec. 14. Pumping against a ¼-in. bean retards the inflow of sand to some extent but has failed to entirely eliminate the difficulty. It is planned to use a smaller size of perforations in B-29 which is now drilling below 2800 ft.

Meridian Oil Co. Turner No. 7, located to the south of B-28, landed on bottom at 3038 ft. a 4¼-in. liner with 300 mesh perforations. This liner was gravel packed and the well is now pumping 350 bbls. a day with a cut of 8.0%.

---

## G. P. Arvin Test In Basement Granite

Precluding any further possibility of deeper production at Arvin, the General Petroleum Co. exploratory well in sec. 27, 31-29, Houchin No. 1, cored into the granite basement at 7920 ft. Preparatory to completing in the 7300-ft. horizon, the hole was plugged from 7928 ft. (bottom) to 7490 ft. where a blank liner was landed and cemented. It is planned to gunperforate in the oil zone.

Last month when showings were first cored in this well a formation test was made of the interval from 7290 ft., where 8⅝-in. casing is cemented, to 7354 ft. During a 12-hour test the fluid reached the surface and flowed 105 bbls, of 30 gravity oil cutting from 20 to 30%. When deepened to 7485 ft., only water with a small amount of oil was recovered during a formation test and the hole was carried down to the basement rock. Houchin No. 1 is located a mile northwesterly from the first try of General Pete, Arvin No. 1, which was abandoned at 7482 ft. after coring a non-commercial body of oil sand at about 7230 ft. The company's third well, Pauly No. 1. is preparing to spud in sec. 22, 31-29, approximately 1000 ft. northwest of the Houchin well.

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## Greeley Adds Two Good Producers

In Greeley, Standard Oil Co. completed K.C.L. No. 11-10 in sec. 17, 29-26 flowing 1645 bbls. a day of 30 gravity oil through a 1-in. orifice. The depth of the hole is 7800 ft. with 7-in. casing cemented at 7713 ft., and a 5-in. perforated liner landed on bottom. Fleishauer Community No. 1 in sec. 20 was carried to 7855 ft. after cementing 9-in. at 7670 ft., but was plugged to 7760 ft. after formation tests indicated the sands wet below that depth. A securaloy perforated liner was landed on the plug and the well swabbed in flowing an unestimated volume of water and oil to the pump. Before deepening, formation tests had indicated this interval is capable of producing 1000 bbls. of clean 60 gravity oil and 10,000,000 cu. ft. of gas.

K.C.L. 12-2, the northeasterly outpost completion in section 16 which has been shut in since its initial test last month, is now flowing 735 bbls. of 31 gravity oil cutting less than 1.0%. A ¼-in. bean holds the flow pressure to 800 pounds while the casing pressure remains at 1450 pounds.

K.C.L. No. 17-1, virtually a wildcat in section 9, is nearing critical depths below 7300 ft. The Greeley sand, if present, may be picked up as high as 7500 ft. if the rising trend from the discovery area continues this far.

South and east of the Standard's production, the Superior Oil Co. K.C.L. No. 9 well in sec. 3, 30-26, is preparing to cement through perforations in an effort to shut off the inflow of mud and water which broke in and killed a promising initial flow of clean oil when the well was first put on production several weeks ago. K.C.L. No. 10, one location to the west, is now drilling below 7200 ft. and is expected to pick up the oil sand at about 7550 ft.

## Ohio Test Extends Ten Section Field

Gauging 2267 bbls. in its first 24 hours the Ohio Oil Co. K.C.L. No. E-3 in sec. 14, 30-25, two and a half miles northwest of Ten Section, has been completed. Following a formation test of the interval 8030-8129 ft. during which the well flowed at a 2000 bbl. rate, a 7-in. water string was cemented at 8095 ft. and the hole deepened through oil sand to 8175 ft. where a securaloy perforated liner was landed. Two and one half inch tubing was run and the well brought in Nov. 20, flowing 37 gravity clean oil through a 1-in. bean with flow pressure 425 pounds and casing pressure 1525 pounds. Accompanying the flow is 1,700,000 cu. ft. of wet gas.

Located on the northwesterly trend from Ten Section, it is yet unknown whether the well marks an extension of that field or the discovery of an entirely new structure.


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## Geophysics Shows San Emigdio Closure

Two important new wildcats have been announced by major companies for the southern part of the San Joaquin Valley.

The Texas Co., following seismographic indications of a structure between and paralleling Mountain View and Edison, has made a location for a test well on the Bastian property 990 ft. north and 330 ft. east from the center of sec. 34, 30-29.

The Shell Oil Co., which has long believed in the possibilities of the San Emigdio area, has selected a location near the w¼ corner of sec. 26, 11-22 on property of the Kern County Land Co. The geology, which has been thoroughly studied by all available means, including a geophysical survey, indicates the existence of a closed structure.

### Test East of Arvin

East of Arvin in sec. 32, 31-20, Petrex, Inc., a new Los Angeles company, has spudded an exploratory well located 628 ft. south and 165 ft. east from the northwest section corner.

---

## Belridge Wagon Wheel Adds To Big Producers

The prolific Wagon Wheel zone at Belridge has yielded another big producer in Belridge Oil Co. No. 43 in sec. 26, 27-20. Flowing initially through a 96/64 orifice, the first gauge was 2338 bbls. in 17 hours wth 320 pounds on the tubing and 1350 pounds on the casing. Gas was estimated at 10,000,000 cu. ft. Using a 4/64-in. bean, the production is now 850 bbls. of 32 gravity clean oil and 2,400,000 cu. ft. gas with pressures of 750 pounds and 1650 pounds. Eight strings of tools are now working representing five companies with the greatest activity centering in territory adjoining The Texas Co. Martin well which was recently completed in section 22 at the north end of the field.

## New Production In Mt. Poso Area

Discovering another productive area at Mt. Poso, the Sunset Oil Co. brought in S.P.L. No. 1 in sec. 3, 27-28 from a depth of 1460 ft. pumping 100 bbls. of 14.5 gravity clean oil. The Vedder zone was reached at 1435 ft. and an 8⅝-in. water string was cemented at 1445 ft. Rig has been erected for No. 3-1 900 ft. southeast of the discovery well.

In sec. 32, 26-28, the Ring Oil Co. completed Loudon No. 2 from 1765 ft. as a 100-bbl. pumper and has Shapiro No. 3 standing cemented with 8⅝-in. casing set over the Vedder Zone which was cored at 1705 ft. Bowles No. 5 in section 29, 26-28 has been mechanically completed at 1760 ft. and is being rigged to pump.

The Vanguard Oil Co. obtained better than 400 bbls. a day in Glide No. 15 in sec. 33, 27-28 when the well was put on the pump with 20 ft. of the Vedder open to bottom at 1758 ft. Dwight Vedder's B.N.B. No. 4 in sec. 32, 26-28 was bottomed at 1752 ft. and completed pumping 202 bbls. cutting 1.0%. The top of the zone was cored at 1700 ft.

## Find 150-Ft. Pay In Mountain View

North American Oil Consolidated completed Tupman No. 2 in the southern "Hot Spot" of the Mountain View field with initial flow estimated at 1400 bbls. of 24 gravity clean oil. Approximately 150 ft. of oil bearing formations are open below the shoe of the water string to bottom at 5565 ft.

In the same area the recently completed Hogan Petroleum Co. Symons-Bankline No. 4 has settled to 475 bbls. of 27 gravity oil. This well is producing in the interval from 5300 ft. to 5515 ft.

Symons-Bankline No. 5 is drilling below 3650 ft., and to the north, in the same section (4, 31-29), Symons-C.C.M.O. No. 5 is making a formation test at 6130 ft.

---

## Well Near Lamont Drilling Below 6500

The Section Six Oil Co. has resumed operations in Johnston No. 1 after a brief shutdown and is now making new hole below 6500 ft. Located in sec. 6, 31-29, between Lamont and the Mountain View field, the company is playing for an entirely new San Joaquin valley floor structure.


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# Los Angeles Basin

## Three Areas Center Wilmington Interest

Interest at Wilmington is now equally divided among three widely separated sections. In the northwest extension, completion of Macson Oil Co. C-55-1 with an initial flow of 500 bbls. of 17 gravity clean oil has encouraged operators to drill as far out as the corner of Robidoux and Avalon streets, where the Brookline Oil Co. (Gus Pongratz) has spudded Webb Community No. 1.

At the intersection of Sanford and "E" streets, Pacific Western Oil Co. has cemented a 6⅝-in. water string in Roman Community No. 1 after a series of formation tests indicated the lower portion of the 5700 ft. hole was productive. Observers are of the opinion that sands cored in this well have better saturation than those encountered in the Royalty Service-Gilmore 842-2 deep test, three blocks west, which is now producing 200 bbls. daily cutting 20% from the interval 5675 to 5747 ft. Should the Pacific Western well come in as a large producer of clean oil, a return of last spring's drilling activity in this area would result.

Completion of three good north line wells by Union Pacific influenced the Bankline Oil Co. to spud Dominguez Harbor Community No. 12 and stake locations for Joint Community Nos. 1 and 2 and Watson Four-No. 6, all of which are situated north of Anaheim Street between Sampson and Lawrence Avenues.

The Union Pacific Railroad has added 1330 bbls. of settled production with the completion of wells Nos. 63, 64 and 65 on a line south of and paralleling Anaheim street. These wells are 3350 ft. deep with water strings cemented at 2950 ft. and are producing from the Ranger and Upper Terminal zones with the interval between closed off with blank pipe.

West of the developed portion of the field, the Don Oil Co. is rigging up for a semi-wildcat test at the corner of "B" and Frigate streets, which if successful will extend production through the entire business section of the city of Wilmington.

The average total production of the field continues around 60,000 bbls. daily as the output of newly completed wells nearly balances the natural rate of decline.

## Union Bell No. 100 Coring Below 11,121

Union Oil Co. Bell No. 100, deep test well in the heart of the Santa Fe Springs field is now coring what is reported to be shale and gray sand below 11,121 ft. Now one of the deepest wells in the state, this test is expected to ascertain once and for all the possibilities of developing deeper production in this structure.

## Severns Takes Over Old Coyote Well

The abandoned Petroleum Securities Co. McNally No. 1 in sec. 24, 3-11, near the southwest edge of the West Coyote field has been taken over by the Severns Drilling Co. The hole will be plugged back from the present depth of nearly 7300 ft. to test upper showings and will be redrilled and deepened to the basement rock if necessary.

## British-American Pico Making Formation Tests

British American Oil Producing Co.'s wildcat test near the town of Pico in sec. 12, 2-12, has made several formation tests which show some gas but have resulted only in recovery of water with negligible oil colors. Total depth is 3990 ft. and the company has stopped drilling while considering the advisability of further work.

## Injunction Stops Long Beach Drilling

Development of the Long Beach side of the Wilmington field hit another legal snag when a local "citizen and taxpayer" got a court injunction restraining the Board of Harbor Commissioners from issuing permits to drill. This move, which came after 17 permits had been approved but not issued, did not surprise oil men in the field. However, plans of several companies which had intended to begin development work with the scheduled opening of the area Nov. 17, were thrown into confusion.

Arguments on making the temporary injunction permanent will be heard in Superior Court Nov. 23. The injunction was granted on the claim that certain former tidelands now filled were unlawfully deeded by the city to the Union Pacific railroad for a cash consideration in settlement of a suit 14 years ago.

The Attorney General's office has not yet sanctioned the acceptance from the city by the Division of Oil and Gas of the bond required to be posted with each notice of intention to drill. The inference may be drawn that the city is not considered a legally bondable person or corporation. Unless the Attorney General rules contrary to present indications, it appears that the city will not be able to drill its own wells as originally planned. Further involvement in legal tangle came when the City of Long Beach was made co-defendant in an action brought by John D. Lauricella to force the State of California to issue him permits to drill a tract of 125 acres on Terminal Island upon which he claims title to the oil through process of mineral entry. Lauricella filed on the tract in January, contending that mineral rights remained with the state when the land was deeded to the city in 1911.

## See Increase In El Segundo Output

Total field production at El Segundo is due for an abrupt increase as soon as five new wells have entered the oil bearing fractured schist in the northwest portion of the field. Before another week several of these wells will be production.

Apex Petroleum Co. Elsie No. 1, Ruchti Petroleum Co. No. 4 and Richfield Oil Co. McCray No. 1, all situated in the townlot section, topped the schist at 6880, 6970 and 6900 respectively. Apex stopped coring at 7105 ft. and has cemented a water string at 6865 ft. while Ruchti cored to 7100 ft. and cemented 6⅝-in. casing at 6885 ft. The McCray well was drilling at 7090 ft. when last reported.

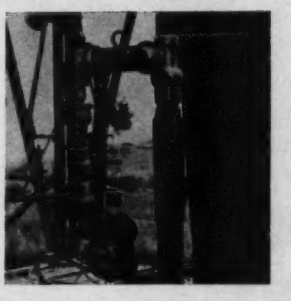
Offsetting the townlot section to the east, Ohio Oil Co. Gough No. 9 has cemented casing over the top of the schist at 7120 ft. after penetrating 300 ft.

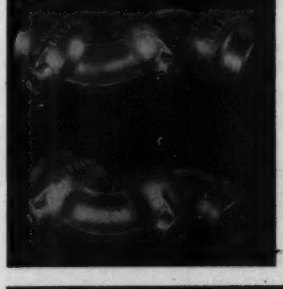
Standard Oil Co. Refinery No. 5, a southerly offset to McCray No. 1, is drilling ahead in the schist below 7045 ft. after coring the top at 7035 ft. All located high on the schist, and in the area where no conglomerate zone is present, these wells should be among the field's better producers.

After topping the conglomerate at 7250 ft. and the basement at 7345 ft. Standard Oil Refinery No. 4, a southwesterly well, landed a perforated liner on bottom at 7475 ft. and is preparing to swab in. Offsetting the Refinery No. 4, The Texas Co. Security No. 5 is alternately swabbing and flowing by heads, apparently unable to maintain steady production. This well encountered the top of the conglomerate at 7230 ft. and penetrated the schist from 7280 ft. to 7405 ft.

Pacific Western Oil Co. Goodwin No. 1, which was completed last month flowing 675 bbls., has stopped flowing and is now pumping at a 250-bbl. rate. Geo. F. Getty, Inc. No. 1A and Ohio Gough No. 8 have been completed as small pumpers.

The Government Refining & Gasoline Co.-Sunshine Oil Co. interests have four wells drilling in the northwest area, two of which are coring the schist below 6800 ft. and the Wilshire Oil Co. has No. 2 coring below 6875 ft. and No. 1 coring at 6800 ft. The total production of the field has dropped steadily since the October peak, moving down to 19,000 bbls. against the high of 24,100 bbls. Recent completions have all been small edge wells bringing a drop in total barrels produced in spite of an increasing number of wells on production. With the development now centering in the northwest area it is probable that this tendency will reverse itself and that new highs will again be established.





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# Coastal District

## Buying Setup Kills Threat Of Santa Maria Valley Wells

Now one of the most active fields in the state with more than 20 wells drilling, the Santa Maria Valley field is the first in the coastal district since the discovery of Elwood to become a major factor in the California industry. Because only one company is in the field with a pipeline and will buy from each operator an amount equivalent to the Oil Umpire's allowable only, there is no immediate threat of serious overproduction and many good wells are shut in entirely. The field is one of the best in recent years from the supplyman's view point, as it is large in area; properties are held by many operators, calling for many offsets; formations are harder than in most of the newer fields, and drilling time is longer and more bits and core heads must be used.

The Sunshine Oil Co. brought in its first well, Wallace No. 1, in sec. 27, 10-34 after coring Monterey from 4085 ft. to the top of the Franciscan at 4465 ft. Eight and five-eighths-inch water string was cemented at 4100 ft. and after landing a perforated liner on bottom at 4493 ft., the well was completed flowing 1245 bbls. in its first 19-hour gauge. With a 38/64-in. bean, flow pressure was 220 lbs. and the casing pressure 400 lbs. The oil is clean and is 15.5° gravity.

In section 21, J. E. O'Donnell completed Lloyd No. 1 at 4759 ft. with a flow estimated at 600 bbls. The Monterey was encountered at 4325 ft. and the Franciscan at 4745 ft. In the same section, Pacific Western completed Hobbs No. 3 pumping 375 bbls. a day with the Monterey open from 4020 ft. to 4264 ft.

### Northern Limit

In the Newlove Acres tract in section 23, Linnel Petroleum Co. has Community No. 1 on the pump making 50 bbls. cutting 25% sand and mud. The top of the Monterey was cored at 3070 ft. and the hole was bottomed at 3211 ft. This well is probably at about the northern limit of commercial production in this part of the field.

### Important Test

Frank Jones made an important formation test in Callison No. 1, a southern outpost well in section 26, 10-34. Much oil and gas was in


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evidence on the ditch after entering the Santa Margarita brown shale at 4537 ft. and with bottom at 4730 ft. a drill pipe test was made of the interval 4565 ft. to 4730 ft. which indicated at least small production is possible above the Monterey.

Wells now in the Monterey and soon to be completed are: Bush Oil Co.-Hancock Oil Co. Wylie No. 1 in section 25; A. N. Macrate Rice No. 2 in section 23; Signal Oil & Gas Co. Libeu No. 1 in section 26; Union Oil Co. Russel No. 3 in section 21, and the York Oil Co. Doane No. 1 in section 27.

### Seek Water Source

The Union Oil Co. has taken LeRoy No. 2 off production and is endeavoring to locate the source of water. This well, although cutting 30%, pumped an average of 100 bbls. a day net, and extended known production two miles to the west. E. H. Moore, Inc. No. 3, an offset, is coring for the top of the Monterey below 5000 ft.

Petroleum Securities Co. has spudded Rembush No. 1 in section 35, 10-34. This test is of great interest to operators holding acreage in the southern part of the field.

## To Start New Test Near Oxnard Area

Another test near Oxnard will soon be underway as the Vaca Oil Exploration Co. is preparing to spud Lennox No. 1 in section 6, 1-21 adjoining its Livingston No. 1 which is now on production from 4285 ft. gauging about 50 bbls. daily of heavy oil.

The Oxnard Oil Co. has made no production test in Vanoni No. 1 which showed considerable quantities of water on a recent bailing test. After carrying the hole to 6302 ft., a plug was set at 6200 ft. to determine the possibilities of heavy oil sands cored from 5700 ft. to 6192 ft. Fluid, which is in part low gravity oil, is now standing at the surface.

## Camarillo Wildcats Focus Coast Interest

With three wildcats now active, Camarillo area is becoming one of the most interesting spots in the coastal region.

Richfield McFarland No. 1 in section 13, 2-21 was drilled to 5295 ft. in hard volcanic formations which have continued for the last 2000 ft., the Southern California Drilling Co. Daly No. 2, section 26, 2-21, is approaching 2000 ft. in depth and The Texas Co. is preparing to spud Edwards No. 1 in section 19, 2-21.

## Resuming Test Near Casmalia

Near Casmalia, Crude Oil Drilling Co., Ltd. has resumed operations on well No. 1, long idle at 1150 ft., and is now deepening in hard brown shale below 1500 ft. The company will continue drilling as far as geological data warrant.


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# State Drilling Report

| Field | Company | Well | No. | Sec. | Twp. | Range |
|---|---|---|---|---|---|---|
| | | **NEW WELLS** | | | | |
| El Segundo | Lakeside Oil Co. | Lakeside | 1 | 12 | 3S | 15W |
| | Richfield Oil Corp. | McCray | 2 | 12 | 3S | 15W |
| | | Republic | 1 | 18 | 3S | 14W |
| | Sunshine Oil Co., Ltd. | Coplinger-Wallace | 2 | 12 | 3S | 15W |
| | Standard Oil Co. | Refinery | 6 & 7 | 13 | 3S | 15W |
| | Wilshire Oil Co., Inc. | Elsie | 2-1 | 12 | 3S | 15W |
| | | Security | 1 & 2 | 12 | 3S | 15W |
| | The Ohio Oil Co. | A. S. Gough | 10 | 7 | 3S | 14W |
| | Howard Oil Co., Ltd. | Mary | 1 | 12 | 3S | 15W |
| Wilmington | Mid-Cal Oil Corp. | Mid-Cal | 5 | 33 | 4S | 13W |
| | General Petroleum Corp. | Terminal | 7 & 9 | 4 | 5S | 13W |
| | | Ford 30, 31, 33, 34, 36, 37, 38 & 39 | 4 | 5 | 5S | 13W |
| | Raleigh Oil Co. | George Patton | 1 | 32 | 4S | 13W |
| | Royalty Service Corp., Ltd. | Fleming 1, Kegy | 1 & K-1 | 32 | 4S | 13W |
| | U. P. Railroad Co. | U. P. | 68, 69, 70 & 71 | 4 | 5S | 13W |
| | | U. P. | 72 & 73 | 3 | 5S | 13W |
| | The Caminol Co., Ltd. | Wilmington Comm. | 2 | 32 | 4S | 13W |
| Long Beach | John M. Abrams | Willis | 1 | 13 | 4S | 13W |
| | Richfield Oil Corp. | Demmi | 11 | 29 | 4S | 13W |
| | Union Oil Co. | Oil Operators, Inc. | 2 & 3 | 13 | 4S | 13W |
| Rosecrans | Warmill Drilling Co. | Moss | 1 | 18 | 3S | 13W |
| Los Angeles County | The Texas Co. | Gardena Community 5 | 1 | 30 | 3S | 13W |
| Imperial County | National Dry Ice Corp. | | 1 | 12 | 11S | 13W |
| Santa Paula | Stallings, Senter & Ahlburg | Stallings | 1 | 24 | 4N | 21W |
| Ventura Avenue | Tidewater Associated Oil Co. | V. L. & W. | 19 | 26 | 3N | 22W |
| Ventura County | The Texas Co. | Edwards | 1 | 19 | 2N | 21W |
| Cat Canyon | Standard Oil Co. | Los Flores Land & Oil Co. | 1 | 27 | 9N | 33W |
| Santa Maria Valley | Union Oil Co. | Russell | 3 | 21 | 10N | 24W |
| | Pacific Western Oil Corp. | Dal Porto | 2 | 27 | 10N | 34W |
| | Sed Oil Co. | | 2 | 27 | 10N | 34W |
| | Hancel Oil Co. | Holser Bailey | 1 | 27 | 10N | 34W |
| Midway | Victor Oil Co. | | 14 | 35 | 32S | 23E |
| | The Texas Co. | | 28, 29 & 30 | 32 | 32S | 24E |
| | Chemeketa Oil Co. | Chemeketa | 1 | 15 | 32S | 23E |
| | C. C. M. O. Co. | | 55 | 21 | 32S | 23E |
| Sunset | Ethel D. Co. | | 21-A | 36 | 11N | 24W |
| | Hallmark Oil Co. | | 9 | 25 | 11N | 24W |
| Belridge | Belridge Oil Co. | | 7-37 | 27 | 27S | 20E |
| | Tidewater Associated Oil Co. | | 2 | 21 | 27S | 20E |
| Lost Hills | Standard Oil Co. | United | 7 | 2 | 26S | 20E |
| Round Mountain | Dwight G. Vedder | Bell | 1 | 12 | 28S | 28E |
| | Fremont Oil Co. | Olcese | 2 | 35 | 28S | 29E |
| | California Western Oil Co., Ltd. | | 7 & 8 | 12 | 28S | 28E |
| | Eastmont Oil Co. | Olcese | 6 | 16 | 28S | 29E |
| Mount Poso | Ring Oil Co., Ltd. | Loudon | 2 | 32 | 26S | 28E |
| | | Bohen | 3 | 32 | 26S | 28E |
| | Dwight G. Vedder | B. N. B. | 4 | 32 | 26S | 28E |
| Kern County | Honolulu Oil Corp. | Honolulu-Associated-S.P. | 33-1 | 33 | 12N | 19W |
| | Universal Consolidated Oil Co. | Tejon | 1 | 33 | 11N | 19W |
| | Vedder Petroleum Corp. | Lamberf | 1 | 25 | 26S | 27E |
| | The Ohio Oil Co. | Tejon Ranch Co. | D-2 | 23 | 11N | 19W |
| | The Superior Oil Co. | K. C. L. | 10 | 3 | 30S | 26E |
| Greeley | Standard Oil Co. | K. C. 11 | 12 | 20 | 29S | 26E |
| | | K. C. 12 | 3 | 16 | 29S | 26E |
| | | K. C. 17 | 1 | 9 | 29S | 26E |
| | The Superior Oil Co. | Krause | 1 | 21 | 29S | 26E |
| Fruitvale | Meridian Oil Co. | Turner | 7 | 23 | 29S | 27E |
| Poso Creek | Pacific Oil & Gas Develop. Corp. | Davidson | 2 | 36 | 27S | 27E |
| Tulare County | J. F. Wilcox | Sears | 1 | 29 | 24S | 28E |
| | | **DEEPEN OR REDRILL** | | | | |
| Huntington Beach | Wilshire Oil Co., Inc. | H. B. | 3 & 4 | 10 | 6S | 11W |
| | Venture Oil Co. | Russell | 2 | 35 | 5S | 11W |
| | Union Oil Co. | Brooks | 2 | 34 | 5S | 11W |
| Montebello | Wilshire Oil Co. | Montebello | 1 | 5 | 2S | 11W |
| | The Texas Co. | Baldwin | 13 | 6 | 2S | 11W |
| Dominguez | Shell Oil Co. | Reyes | 21 | 34 | 3S | 13W |
| | Union Oil Co. | Callender | 50 | 33 | 3S | 13W |
| Torrance | C. C. M. O. Co. | Torrance | 33 | 15 | 4S | 14W |
| Long Beach | Dye & Spath | Liebert Comm. | 1 | 24 | 4S | 13W |
| Richfield | F. & D. Oil Co. | Davis | 1 | 23 | 4S | 9W |
| Rincon | C. C. M. O. Co. | Hobson | B-11 | 8 | 3N | 24W |
| | Rincon Oil Co. | Rhudde | 3 | 7 | 3N | 24W |
| Ventura Avenue | Shell Oil Co. | Taylor | 60 | 29 | 3N | 23W |
| Santa Maria Valley | Union Oil Co. | Vincent | 2 | 30 | 10N | 33W |
| | | Bradley Lands | 1 | 25 | 10N | 34W |
| Midway | Brookshire Oil Co. | | 13 | 24 | 31S | 23E |
| | Standard Oil Co. | | 7 | 13 | 32S | 24E |
| | Edw. H. Mitchell Co. | | 6 | 15 | 31S | 22E |
| Elk Hills | B & M Oil Co. | | 1-A | 26 | 30S | 24E |
| Edison | Westbrook Co. | Westbrook | 1 | 4 | 30S | 29E |
| Mountain View | The Hancock Oil Co. | Miller | 7 & 8 | 14 | 30S | 28E |
| | Hogan Petroleum Co. | Porter-Day | 9 | 29 | 30S | 29E |
| Fruitvale | Mohawk Petroleum Co. | | 5 | 27 | 29S | 27E |
| | General Petroleum Corp. | Hensley | 4 | 22 | 29S | 27E |
| | Western Gulf Oil Co. | Red Ribbon Ranch | 1 | 27 | 29S | 27E |
| Kettleman North | Kenda | | 1 | 28 | 21S | 17E |
| | Kenda | | 61 | 30 | 21S | 17E |
| | | **ABANDON** | | | | |
| Huntington Beach | Pacific Western Oil Corp. | Montgomery | 1 | 10 | 6S | 11W |
| Santa Fe Springs | General Petroleum Corp. | E. O. B. | 101-B | 6 | 3S | 11W |
| | | Hill-Midway | 103 & 105 | 6 | 3S | 11W |
| Los Angeles County | Willard Oil Co. | Sweet | 1 | 6 | 2N | 16W |
| | Wright Oil Tool Co. | Wright | 1 | 1 | 5N | 12W |
| Rosecrans | Bolsa Chica Oil Corp. | Exeter | 3 | 20 | 3S | 13W |
| Inglewood | The Texas Co. | Smith | 6 | 7 | 2S | 14W |
| Torrance | Margaret L. Stephens | | 6 | 6 | 4S | 14W |
| Long Beach | Richfield Oil Corp. | Booth | 15 | 28 | 4S | 12W |
| | Vessels, Harmon & Evans | Irwin | 1 | 24 | 4S | 13W |
| Rincon | Richfield Oil Corp. | Hobson-Fee | 5 | 8 | 3N | 24W |
| Santa Barbara County | Tidewater Associated Oil Co. | Leonis | 1 | 3 | 6N | 33W |
| San Luis Obispo County | Carlisle Oil Co. | | 1 | 19 | 11N | 25W |
| McKittrick | Birch Ranch & Oil Co. | Lovitt | 1 | 10 | 30S | 21E |
| Midway | C. C. M. O. Co. | | 1 | 30 | 32S | 24E |
| | No. American Oil Consolidated | | 41 | 30 | 31S | 24E |
| Kern River | Alfred Fuhrman | | 12 | 28 | 28S | 28E |
| Elk Hills | Richfield Oil Corp. | Crampton | 3-B | 6 | 31S | 25E |
| Greeley | Standard Oil Co. | K. C. 11 | 8 | 18 | 29S | 26E |
| Kern County | British-American, Inc. | Smith | 1-A | 21 | 31S | 27E |
| Yolo County | Standard Oil Co. | Peter Cook | 1 | 32 | 12N | 1W |
| Stanislaus County | The Texas Co. | Bacon | 1 | 30 | 6S | 8E |

| Summary | Past Two Weeks | Preceding Two Weeks | This Year To Date | Last Year To Date |
|---|---|---|---|---|
| Total New Wells | 79 | 76 | 1406 | 938 |
| Total Deepened or Redrilled | 29 | 32 | 604 | 690 |
| Total Abandoned | 23 | 20 | 456 | 404 |

## Reach Vaqueros Pay In Sespe Cable Job

Dr. Fredrick A. Speik, successful Huntington Beach and Yorba Linda operator, has drilled into the Vaqueros oil sand at 3290 ft. in his Sespe test well located in section 33, 5-19. Because of the steeply dipping hard formations encountered, cable tools are used exclusively in this area.

# California Crude Oil Production

For Three Weeks Ended November 16, 1937

| Field | November Daily Quota | Average Daily Production | Excess |
|---|---|---|---|
| **San Joaquin Valley** | | | |
| Belridge—North | 16,070 | 16,820 | 750 |
| Belridge—South | 1,935 | 1,621 | *314 |
| Buena Vista | 18,355 | 17,483 | *872 |
| Coalinga—East | 11,715 | 10,901 | *814 |
| Coalinga—West | 5,130 | 5,363 | 233 |
| Coffee Canyon | 4,170 | 4,836 | 666 |
| Edison | 3,510 | 3,951 | 441 |
| Elk Hills | 8,630 | 10,971 | 2,341 |
| Fruitvale | 8,600 | 8,614 | 14 |
| Greeley | 2,650 | 2,382 | *268 |
| Kern Front | 10,365 | 10,709 | 344 |
| Kern River | 5,260 | 2,676 | *2,584 |
| Kettleman No. Dome | 79,700 | 81,408 | 1,708 |
| Lost Hills | 4,805 | 3,895 | *910 |
| McKittrick | 3,755 | 4,244 | 489 |
| Midway-Lakeview | 10,780 | 19,326 | 8,546 |
| Midway-Maricopa | 36,970 | 36,488 | *482 |
| Mount Poso | 16,990 | 19,752 | 2,762 |
| Mountain View | 16,325 | 17,094 | 769 |
| Round Mountain | 9,360 | 10,971 | 1,611 |
| Ten Section | 3,430 | 3,275 | *155 |
| Other Fields | 2,730 | 3,403 | 673 |
| TOTAL | 281,295 | 296,243 | 14,948 |
| **Coastal District** | | | |
| Elwood | 7,160 | 7,951 | 791 |
| Rincon | 2,915 | 4,039 | 1,124 |
| Santa Maria | 16,220 | 13,629 | *2,591 |
| Santa Paula-Newhall | 5,400 | 5,050 | *350 |
| Ventura Avenue | 33,010 | 37,015 | 4,005 |
| Other Fields | 6,530 | 7,473 | 943 |
| TOTAL | 71,235 | 75,157 | 3,922 |
| **Los Angeles Basin** | | | |
| Alamitos Heights | 1,255 | 1,658 | 403 |
| Brea-Olinda | 8,930 | 6,150 | *2,780 |
| Coyote—East | 2,930 | 4,244 | 1,314 |
| Coyote—West | 9,295 | 8,605 | *690 |
| Dominguez | 25,130 | 29,117 | 3,987 |
| El Segundo | 6,880 | 20,540 | 13,660 |
| Huntington Beach—New | 16,520 | 21,151 | 4,631 |
| Huntington Beach—Old | 14,585 | 16,870 | 2,285 |
| Inglewood | 16,020 | 16,109 | 89 |
| Long Beach | 52,785 | 58,082 | 5,297 |
| Montebello-Extension | 7,645 | 7,895 | 250 |
| Playa del Rey | 7,525 | 7,984 | 459 |
| Richfield | 8,030 | 9,146 | 1,116 |
| Rosecrans-Athens | 2,590 | 4,396 | 1,806 |
| Santa Fe Springs | 37,245 | 41,667 | 4,422 |
| Seal Beach | 7,695 | 7,398 | *297 |
| Torrance-Hermosa and Extension | 6,720 | 7,619 | 899 |
| Wilmington | 43,020 | 608,05 | 17,785 |
| Other Fields | 2,010 | 2,350 | 340 |
| TOTAL | 276,810 | 331,786 | 54,976 |
| STATE TOTAL | 629,340 | 703,186 | 73,846 |

*—Shortage.

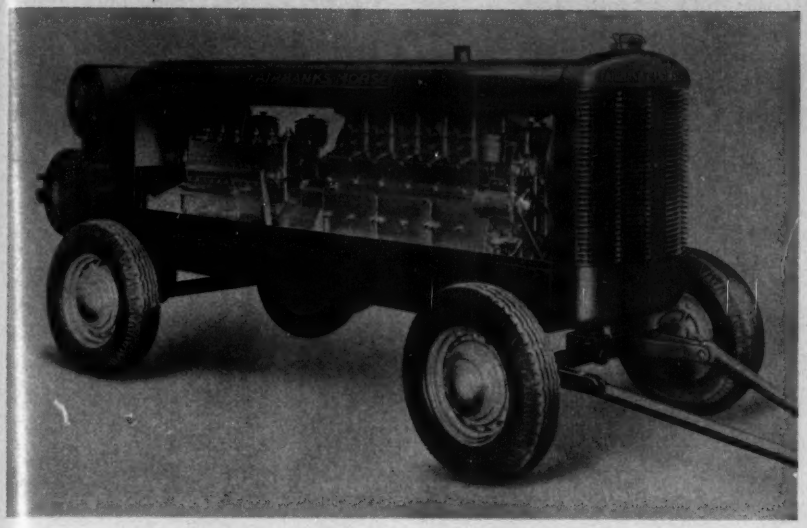
## Union Starts Two In Old Santa Maria

The Union Oil Co., now one of the most active in development work, has two new projects started in the old Santa Maria field. In section 26, 9-34 Cal Coast No. 17 is drilling below 4000 ft. and in section 27, 9-34 Squires No. 20 is getting ready to spud in.

## Spud Near Old Wells In Timber Canyon

Drilling with cable tools, Stallings, Senter & Ahlberg of Los Angeles and Huntington Park have spudded a well near the old production in section 24, 4-21. These shallow Timber Canyon wells have for years produced small quantities of high grade oil.

## New Diesel-Powered F.-M. Compressor



Fairbanks, Morse & Co. has announced a new self-contained, Diesel-powered, 210-c.f.m. air compressor, available with several types of portable and semi-portable mountings, for a wide range of service applications. This new compressor combines the economy and dependability of the F-M Model 36-A Diesel with the superior design features of a proved air compressor, making available a compact, light-weight unit that offers maximum efficiency and absolute reliability under all working conditions.

The compressor unit has been kept light in weight and small in size, contributing to its portability. Ample bearing surfaces and proper lubrication make possible a long trouble-free life. The water cooling system assures thorough and uniform cooling in any climate and under any condition. Low upkeep expense results from the employment of refinements of proved automotive engine design.

The compressor is designed to operate at full engine speed, permitting direct-connection to the engine without reduction gears or belts and without sacrificing engine horsepower through reducing the rated speed.

The F-M Model 36-A, four- cycle, six-cylinder, medium-high speed Diesel engine offers true Diesel economy with necessary flexibility. Its compact, clean-cut appearance is outward indication of inbuilt sturdiness to withstand hard usage. Reliability results from simplicity of design with few moving parts, absence of delicate mechanisms and the use of simple adjustments where any are required. Durability is obtained by the generous proportioning of parts in stress and use of only highest grade materials. The engine is designed to permit easy inspection and servicing.

The new air compressor is availbale with several types of mounting: wooden skid, steel wheel, solid or pneumatic rubber tired wheel, four- or two-wheeled trailer, and motor or railway truck. Specifications will be found in Bulletin 3645-A1, available upon request from Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

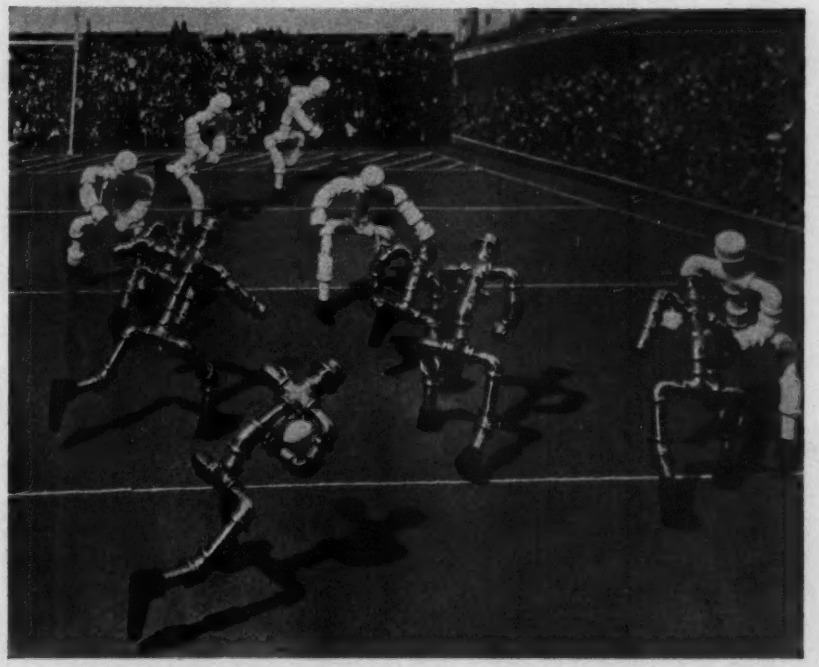
## Youngstown Booklet Pictures Steel Making

A book of unusually instructive photographs which pictorially tell the story of steel from iron ore mine to finished products has just been published by The Youngstown Sheet & Tube Co.

Compiled in the style of popular picture-story magazines using action photographs and brief, to-the-point captions, the book contains 115 pages of basic steel information including a total of 135 action photographs taken in the company's mines and mills. The book is entitled "What We Make and How We Make It".

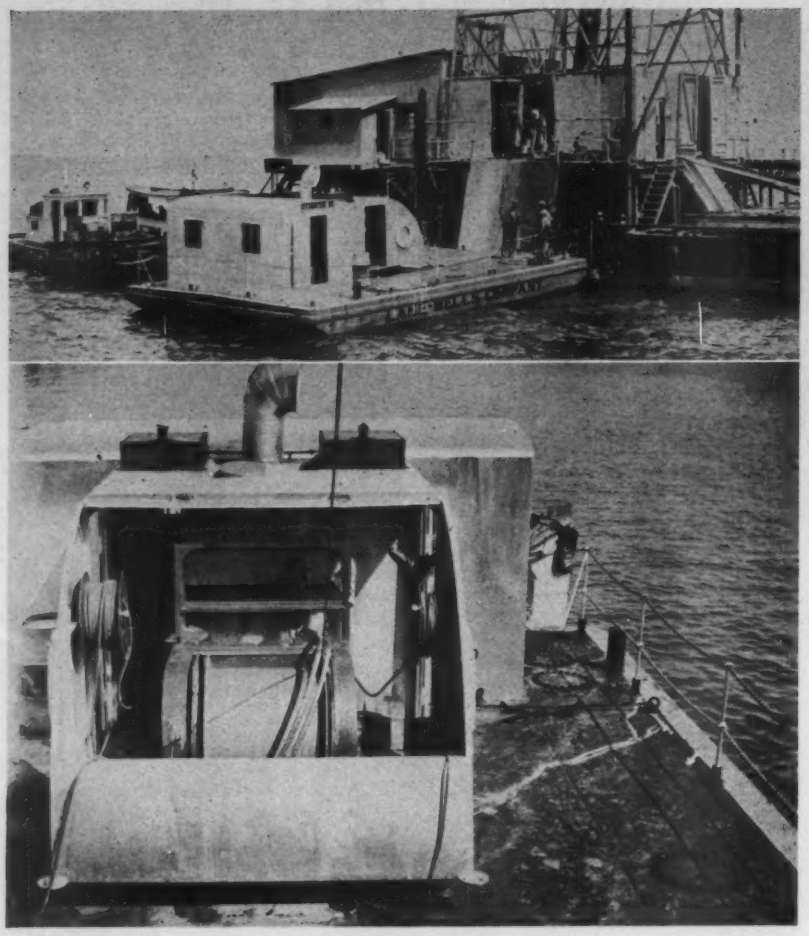
The first section of the book covers the story of steel from iron ore mining to the pouring of ingots and the cutting of billets. Thirteen other sections illustrates the manufacture of flat rolled steel, flat rolled steel in lighter gauges, tin plate, butt weld pipe, lap weld pipe, seamless pipe, electrical weld pipe, electrical conduit, rods and wire, wire nails, bars and shapes, railroad tie plates and forged steel unions.

The book is handsomely printed in convenient pocket size and bound in a leatherette cover.



A Los Angeles idea which scored a nation-wide touchdown. T Stahr of the Los Angeles branch of Crane Co., constructed the original "player" from pipe fittings in the branch stock room at 321 East Third St. The sample was sent to the Crane general offices in Chicago where these two contending teams were erected in a realistic background. The display is being sent to cities where outstanding games occur and will wind up the season at the Los Angeles branch of Crane Co., at the time of the Pasadena Rose Bowl game.

## Barge Is Sea-Going Gun-Perforator



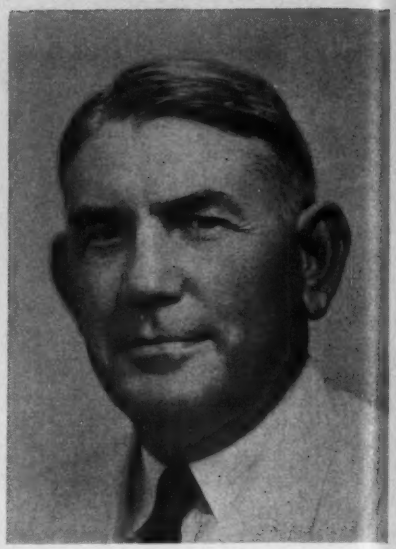
The newest development in the Lane-Wells gun-perforating service is the "streamlined" barge unit No. 1 operating in the coastal oil fields of Louisiana. This utility barge, built by the Pennsylvania Shipyards, provides the first gun-perforating ever done by boat, and was designed at the suggestion of The Texas Co., the major operator in the Lake Charles district. The barge can be used in shallow inland channels as well as in open water. Its length, breadth, and draft are such that it will negotiate any "location canal." It is large enough, however, to ride moderately rough water in open bays.

The new barge is equipped with all necessary apparatus for maintaining the unit independent of the Lane-Wells branch office at Lake Charles, Louisiana. This self-sufficiency was made necessary because of the nature of the water locations, their distance from operating points, and the slowness of transportation.

Aboard the barge, the operating machinery is housed in a substantial cabin built in the streamline style of the well-known Lane-Wells truck. The rear door slides up far enough to allow the shooting cable to leave the drum at any angle from horizontal to vertical. This is a necessity on water location, since most of the time shooting equipment will be less than 50 feet from the casing. In order to save time and to facilitate "tying up," the operating cabin enclosing the hoist is built on a turn-table. This allows the crew to "tie up" at the best mooring place and then line up the hoist for best operating conditions. The hoisting engine and power plant are closed off in a fireproof engine room for safety and quiet operation. All of the apparatus, including the controls, is placed for maximum efficiency and ease of maintenance.

This unit, the "Ittybitsie W," under the "command" of "Captain" P. V. Tillbury, is now stationed at The Texas Co's operating depot at Montegue, Louisiana from which point it has access to practically all fields in coast waters.

## Blaine Johnston In New Position



Blaine Johnston, formerly vice-president of Sims Oil Co. and chairman of the Southwest District of the A.P.I., has been made secretary-treasurer and general manager of the Johnston Oil Field Service Corp., with headquarters at Houston. In his new capacity he will have direct supervision of formation and casing testing operations in the Mid-Continent, Texas and Louisiana Gulf territories.

In addition to being former chairman of the Southwest division of the A.P.I., he is also former chairman of the Louisiana and Arkansas divisions.

## Cavins Bailer Sold To Washington Operator

G. W. Moore, manager of the California rental service agencies and national advertising for the Cavins Co., Long Beach, reports a recent shipment of a Cavins hydraulic suction bailer to the People's Oil and Gas Development Co., at Euphrata, Washington.

Paul Cavins, president of the Cavins Co., will personally supervise the work of getting the bailer started; making the trip to Portland by airplane, where he purchased a car in which to drive to and from location. He was accompanied on the trip by Mrs. Cavins and Paul Cavins, Jr. After the work at the well was satisfactorily under way, the Cavins family visited various points of interest in Washington and the Pacific Northwest; combining business with a vacation tour of the Pacific Coast.

## Westinghouse Creates New Products Division

The responsibility for the development of lines of activity which either are new in the art or which have not been previously undertaken by the company has been centralized by the Westinghouse Electric and Manufacturing Co. with the formation of a new product division. Functioning the same as the other operating units of the company, this division will include separate engineering, manufacturing and sales departments.

In its new capacity the division will concentrate its facilities for the development and broadening the field of applications of products which have not reached the state of commercial apparatus. Then, after the field for each new product has been determined and the product has passed through the pilot plant stage, it will be absorbed by one of the regular company divisions.

H. M. Wilcox is manager of the new division with H. W. Tenney as engineering manager and George F. Begoon as sales manager.

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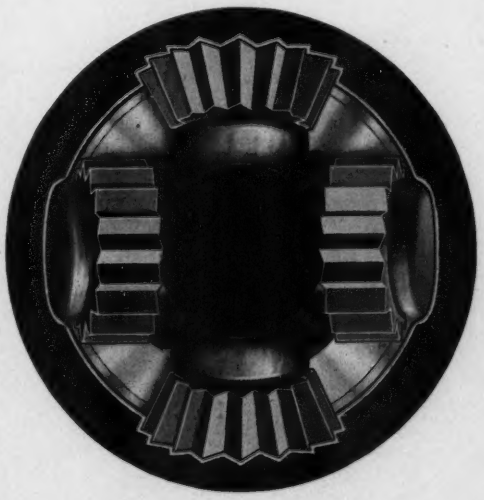
## Smith Announces Hard Core Bit

The H. C. Smith Oil Tool Co. announces the addition of the Type H-F hard formation rock core bit in rental service in California. The bit is interchangeable on the regular soft formation barrels. The construction of the bit emphasizes sturdiness, with increased cutter, pin, and bearing diameters. In addition, tooth depth eliminates balling of cutter teeth, thus increasing speed and total footage obtained. The H. C. Smith Oil Tool Co., Box 431, Compton, will send a rental bulletin to anyone interested.

## Baash-Ross Holds Company Picnic

L. F. Baash snapped while awarding first prize to a fair contestant at the Baash-Ross Tool Co.'s employees' picnic recently held at the Lakewood Country Club in Long Beach, California.

Climaxing weeks of preparation on the part of the executives delegated to the task, Baash-Ross Tool Co. recently held an all-day picnic for all employees of the company and their families at the Lakewood Country Club in Long Beach, Calif. More than 1000 persons were in attendance, and the entire country club, including clubhouse facilities, restaurant, cardrooms, ballroom, an 18-hole golf course, ball diamond and other recreation grounds were at the disposal of the picnic guests exclusively for the entire day. All sorts of games from golf to egg races were organized, affording an opportunity for everyone to compete for carefully selected prizes. Pony rides, ice cream, candy and special games were available to the hundreds of children. An excellent dinner was served in the dining-rooms to all the guests. Toward the close of the day more than 36 major prizes and many second and third prizes were awarded to the winning contestants by L. F. Baash, president of the company, assisted by H. C. Ross, vice president, and the other executives.



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## Lubes Symposium Issued By A. S. T. M.

The papers and discussion comprising the A.S.T.M. Symposium on Lubricants (1937) summarize and bring up to date available information on motor oils and their applications. The symposium is limited to motor car engine lubricants.

The firset paper discusses "Engine Deposits — Causes and Effects" covering such subjects as combustion chamber deposits, valves, ring clogging and crankcase deposits. The paper on "Automotive Bearings—Effect and Design and Composition on Lubricants" covers lubricating system design, equipment for testing bearings, design factors and composition of bearing material.

Topics discussed in the paper on "Addition Agents for Motor Oils" include oiliness agents, pour inhibitors, viscosity index improvers, anti-oxidants, and carbon removers. "How to Select a Motor Oil from the Standpoint of the Consumer" is covered in the fourth paper which points out factors concerning oil viscosity, rate of replenishment, mechanical failure and contamination.

Copies of this publication, 89 pages, can be obtained from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, at $1.25 per copy in heavy paper cover.

# Business and Professional Directory


THE
HANCOCK OIL COMPANY
of
CALIFORNIA

PRODUCERS - REFINERS
MARKETERS

J. R. PEMBERTON
Oil Umpire
1110 Security Title Insurance Bldg.
Los Angeles, Calif.
TRinity 9705

MARTIN VAN COUVERING
PETROLEUM ENGINEER
405 South Hill Street
LOS ANGELES
CALIF.
MIchigan 8781

THE PETROL
CORPORATION
Producers and Refiners
Petrol Gasoline - Super Petrol Gasoline
Kerosene - Fuel Oils - Diesel Oil - Asphalts
Road Oils - Lubricating Oils
Distillates
4020 Bandini Blvd. - Los Angeles, Cal.

GRAYDON OLIVER
PETROLEUM ENGINEER
215 West 7th Street
Los Angeles, Calif. VAndike 3696

SMITH-EMERY CO.
Since 1904
Oils Tested
Shipments Certified
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651 Howard St., San Francisco


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### WATER DEVELOPMENT GUARANTEED

Water surveying service. David Rooney, Phone Wilmington 1918, 587 Broad Ave., Wilmington, Calif. tf

### REFINERIES AND GASOLINE PLANTS

Reconditioned or new heat exchangers, stills, fractionators, absorbers, condensers, at cut prices. Plants designed any size for any use. W. F. Pyne, 909 S. Ardmore Ave., Los Angeles. DRexel 1412. tf

### SCOUT REPORTS

NEW MEXICO LEASEHOLDERS: For reliable information on New Mexico developments take my weekly scout report. W. S. Patterson, Santa Fe, N. M.

### FOR SALE OR RENT

Butane powered portable rotary outfit with power pump, perfect condition. For sale or rent. Angelus Pipe and Supply Co., 2423 E. 54th St., JEfferson 4358. 11-20d

### PIPE

10,000 ft. 6" O. D. plain end, 10,000 ft. Std. 2" T.&C., also 700 ft. 10" Std. P. E. and T.&C. slightly used. Also Conductor pipe, Surface Casing, used, at low prices.
IMPERIAL PIPE & SUPPLY CO., 2501 Santa Fe Ave., Los Angeles, Calif., Phone JE. 1104. 12-5-b-tf

### WANTED

Prospective or producing oil royalties, preferably in California fields. Box 5704, Metropolitan Station, Los Angeles, California. 12/20b


MAPS
Large map of Los Angeles Basin oil fields and map showing all California oil fields. Price $15.00 each on paper and $20 each on cloth. Individual state oil and gas maps of Mid-Continent and Rocky Mountain regions. Maps show geological cross sections at base. These maps indicate wells drilling, wells producing and abandoned, with depths.
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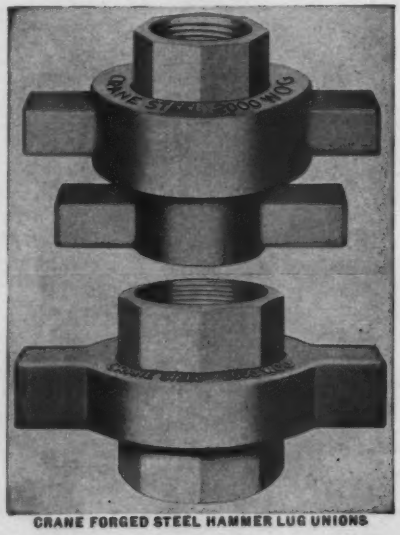
Los Angeles, Calif.
Phone: TUcker 7530

GEORGE A. MACREADY
Geologist and Engineer
Core Orientation Service
Formation Tester Service
Phones: ADams 6706 Res. VErmont 8788
3478 S. Main St. LOS ANGELES


## Crane Offers Hammer Lug Steel Unions



CRANE FORGED STEEL HAMMER LUG UNIONS

Another addition to the family of Crane products is a new line of hammer lug unions. Actually, these unions comprise two distinct lines: (1) forged steel screwed unions with one set of lugs, and (2) forged steel screwed unions with two sets of lugs. Both of these unions have been designed for use in piping systems requiring frequent, or quick, dismantling, either to save time on the job, or for emergency purposes. In either case, a blow with a hammer upon the lug will immediately break the joint without using a wrench.

The oil industry has found that these unions save much time and labor in field work around the boiler, because frequently, a complete unit has to be dismantled in a hurry and moved to a new location.

The single lug union is made with forged steel tailpieces and thread pieces in sizes 2, 2½, 3 and 4-inch (these parts are of cast steel on the 4-inch size) and have lugs on the union ring. The double lug union is all forged steel, having lugs on both the union ring and the thread-piece. It is made in sizes ⅜, ½ and ¾-inch.